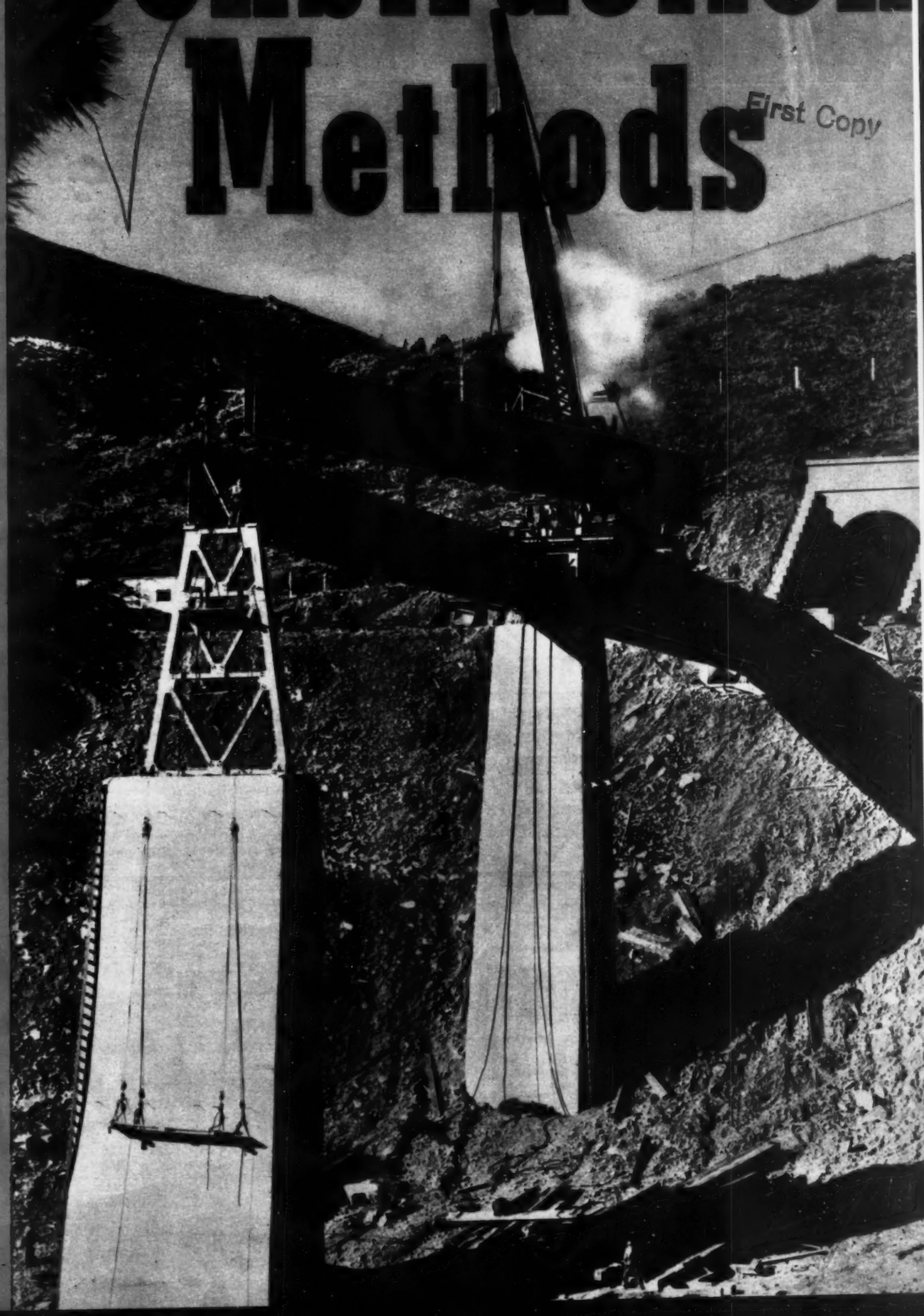
A PICTORIAL SURVEY OF CURRENT PRACTICE, EQUIPMENT AND MATERIALS

Construction Methods



JULY 1940

FOR NATIONAL DEFENSE

The United States has launched a vast program of national defense, to which the construction industry will contribute its essential services.

This and forthcoming issues of CONSTRUCTION METHODS will describe and illustrate construction activities that aid both military and industrial preparedness. These articles will be identified by the symbol herewith:

In this issue articles on construction related to national defense include: The New Airport at Washington, D. C. • • • Construction's Role in Defense • • • Pennsylvania's New Superhighway Linking Important Industrial Areas.

★

HIGHWAYS FOR DEFENSE

A statement by Col. Louis Johnson, Assistant Secretary of War

★

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TUNNEL MEETS BRIDGE

At crossing of Sacramento River near U. S. Bureau of Reclamation's Shasta dam project in California where railroad relocation around reservoir involves eight major bridges and twelve tunnels.

Before You Plan Any Piling Job ...Talk to Inland!

There are possible time and money-saving short cuts on every piling job. Experienced and capable Inland Engineers, working daily on all kinds of piling projects, know how construction costs can be cut. They are ready to aid you with money-saving design and construction ideas as well as show you why Inland Steel Sheet Piling drives freely and straight, forms a tight job and can be reused many times. This Inland service is yours, without cost or obligation. Write for illustrated book on Inland Piling.

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38 S. Dearborn St., CHICAGO • District Offices: MILWAUKEE • DETROIT • ST. PAUL • ST. LOUIS • KANSAS CITY • CINCINNATI

CURRENT JOBS

....and Who's Doing Them

BUILDINGS

Public—In Washington, D. C., **C. H. Tompkins,** local contractor, will build a drill hall and heating plant for the National Guard Armory at price of $1,182,000. Navy Department awarded contract for general storehouse at fleet supply base in Oakland, Calif., to **Johnson, Drake & Piper,** local contractor, for $918,690. Another Oakland, Calif., contract calling for four storehouses at fleet supply base went to **N. P. Severin Co.,** of Chicago, Ill., for $1,045,000. Contract for housing project in Elizabeth, N. J., to consist of 405 units, went to **Andrew Christensen,** local contractor, for $977,000. **Stoffiet & Tillotson,** of Philadelphia, Pa., will construct a 350-unit housing project in Chester, Pa., for $817,111. **W. R. Goss Co.,** of Chicago, Ill., received general contract for 604-unit housing project in Dayton, Ohio, for $1,287,000. The Department of Munitions and Supplies of Ottawa, Ont., Canada, awarded contract for shell-filling plant to be erected in Quebec, to **Canadian Car & Foundry Co. Ltd.,** of Montreal, Canada, for $8,000,000. Successful bidder for a 222-unit housing project in Fall River, Mass., was **Thomas O'Connor & Co.,** of Cambridge, for $722,000.

Commercial—In Cleveland, Ohio, contract for 7-story brick, steel and concrete apartment house was awarded to **William Dolin Construction Co.,** local contractor, for $400,000. **Hegeman-Harris, Inc.,** of New York City, received contract for group apartment house to be constructed in Cleveland, Ohio, for $2,500,000. The **Long Construction Co.,** of Charleston, S. C., will erect in that city 200 one-story frame residences for $500,000. General contract for a 4-story brick newspaper building for Northwest Publications, Inc., in St. Paul, Minn., will be built by **P. Steenberg Construction Co.,** local contractor, for $550,000.

Industrial—Assembly plant for Boeing Aircraft Co., in Seattle, Wash., is to be constructed by **Austin Co.,** of Cleveland, Ohio, for $1,175,000. Schaefer Brewing Corp. awarded contract for bottling plant in Brooklyn, N. Y., to **Turner Construction Co.,** of New York City, for $500,000. A powder plant in Memphis, Tenn., for the Tennessee Powder Co. will be erected by local labor under the supervision of **E. I. Du Pont de Nemours & Co.,** of Wilmington, Del., for $15,000,000. A chemical plant for Carbide & Carbon Chemical Corp., will be built in Texas City, Tex., by **Ford, Bacon & Davis, Inc.,** of New York City, for $2,600,000. A machine shop for Chrysler Corp. in Highland Park, Mich., is under construction by **Albert Kahn, Inc.,** of Detroit, for $1,000,000. Blast furnace in Lorain, Ohio is under construction by **Arthur G. McKee & Co.,** of Cleveland, for $1,500,000. Contract for plant and two-story office building in Bendix, N. J., went to **Austin Co.,** of Cleveland, Ohio, for $300,000.

HEAVY CONSTRUCTION

At Gravelly Point, Va., hangars and terminal buildings will be constructed by **John McShain, Inc.,** of Philadelphia, Pa., for $2,177,200. Contract for naval training base in Corpus Christi, Tex., was awarded to **Brown & Root, Inc., W. S. Bellows Construction Co.,** both of Houston, and **Columbia Construction Co.,** of Oakland, Calif., for $23,381,000 cost plus fixed fee basis. Natural gas pipe line across Western Pennsylvania is under construction by **Williams Bros. Corp.,** of Tulsa, Okla., for $1,800,000. **T. E. Connolly,** of San Francisco, California, obtained contract for rolled earth-fill dam in Cottage Grove, Ore., for $769,930. Outlet works for Blue Mountain dam in Waveland, Ark., went to **John Kerns Construction Co.,** of Omaha, Neb., for $686,877. Contract for dredging San Diego Harbor in California, went to **San Francisco Bridge Co.,** of San Francisco, for $1,175,880. Successful bidder for channel improvements in Johnstown, Pa., was **Leo Butler Co.,** of Silver Springs, Md., for $719,004. **Marsch Construction Co.,** of Chicago, Ill., obtained contract for flood control levee in Lawrenceburg, Ind., for $838,469.

HIGHWAYS AND BRIDGES

Among recent highway and bridge contract awards are the following: California: $169,610 to **J. E. Haddock,** of Pasadena. Indiana: $228,253 to **Grace Construction & Supply Co.,** of Fort Wayne; $254,906 to **Putnam & Greene, Inc.,** of Fort Wayne. Kentucky: $578,255 to **Ralph E. Mills Co.** and **Wood & Barton,** of Frankfort. Montana: $299,737 to **McNutt Bros.,** of Eugene, Ore.; $243,010 to **Collinson & Dolven,** of Billings. New York: $881,333 to **Del Balso Construction Corp.,** of New York City; $597,239 to **Arute Bros., Inc.,** of New Britain, Conn.; $740,545 to **Tomasetti Contracting Corp.,** of Brooklyn, N. Y. Pennsylvania: $581,446 to **Baldwin Bros. Paving Co.,** of Cleveland, O.; $447,671 to **Frank Donatelli & Co., Inc.,** of Pittsburgh; $441,188 to **Williams Construction Co.,** of Middle River, Md.; $360,873 to **D. A. Kessler Construction Co., Inc.,** of Mt. Carmel, Texas: $1,789,906 to **Brown & Root,** of Houston.

Grade crossing elimination contract for $3,025,000 in Brooklyn, N. Y., was awarded to **Poirier & McLane Corp.,** of New York. Contract for substructure highway bridge in St. Georges, Del., went to **Penker Construction Co.,** of Cincinnati, Ohio, for $931,500. Reinforced-concrete viaduct in California, is under construction by **Healey-Moore Co.** and **Frederickson & Watson,** of Oakland, for $380,999.

The HOW of it

For the benefit of readers concerned with the practical application of method or equipment the following references are to articles or illustrations in this issue that tell:

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THE JOB JESTER

CARTOONS DRAWN FOR CONSTRUCTION METHODS

"But if I draw the curtains, Miss DuPrey, the riveter over there will start that awful racket again."

"I'm wearing it home. My wife's on the warpath again."

"But, boss – golfers have them!"

WHAT PRICE FORM SETS?

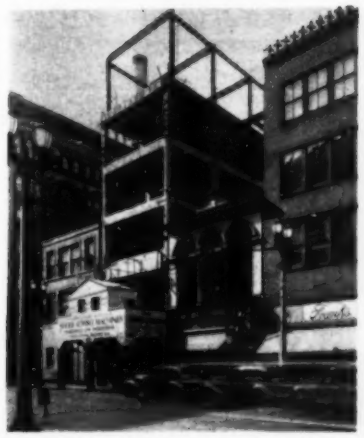


FIGURE 'INCOR' SAVINGS THIS QUICK, EASY WAY

ADD LONG-TIME DURABILITY TO FIRST COST ECONOMIES

THE faster forms can be re-used, the lower the cost per floor or per cubic yard of concrete. But early form removal depends upon the amount and kind of cement used, and that introduces the factor of total cement cost. Time costs also have to be considered—for the sooner a job is completed, the lower the job overhead charged against it.

So it boils down to this: Find the erection schedule which shows the LOWEST OVERALL COST—taking time, forms and cement into consideration. It doesn't take much figuring, and it often saves a lot of money. Witness the fact that on recent jobs dependable 'Incor' high early strength saved from 38¢ to $1.96 per cu. yd. of concrete.

And on jobs on busy city streets, like the new building in St. Louis for the Singer Sewing Machine Company, shown above (Klipstein & Rathmann, architects; W. J. Knight & Co., structural engineers; Gamble Construction Co., contractors), 'Incor' concrete placed one day, permits off-street storage of materials the next. That saves cost of planking or other temporary expedients. Get details of 'Incor'* savings—write for copy of "Cutting Concrete Costs." Lone Star Cement Corporation, Room 2261, 342 Madison Ave., New York.

*Reg. U. S. Pat. Off.

QUALITY PAYS . . . INSIST ON 'INCOR'

'Incor' 24-HOUR Cement means just what the name says—uniform, dependable 24-HOUR service strength. AND LONG-TIME DURABILITY, TOO—proved by 13-year performance record . . . a vital advantage EXCLUSIVE with 'Incor', the FIRST high early strength Portland Cement. Quality pays . . . because better cement makes better concrete.

LONE STAR CEMENT CORPORATION

MAKERS OF LONE STAR CEMENT • • • 'INCOR' 24-HOUR CEMENT

Mechanized Crane Service

It's in tune with the times! A 100% mechanized crane of Center Drive design that travels speedily on 10 rubber-tired wheels from job to job—performs with the same efficiency as other famed Lorains of equal capacities, and is readily converted to shovel, dragline, clamshell or backdigger. That's the Moto-Crane*—a new, highly mobile crane of all work that's clicking with contractors from coast to coast.

The Moto-Crane* is mounted on a Crane Carrier—not a motor truck—which was designed exclusively for crane mounting by an engineer experienced in the development of rubber-tired off-the-road vehicles for military purposes. As a result, you get on your every-day jobs such important features as "soft-ground flotation" and strength to withstand impacts and shocks in this modern Crane Carrier, plus 3 axle mounting on 10 rubber tires, shorter wheelbase, rocker arm rear end and high speed travel.

The Moto-Crane* is available in four sizes ranging from minimum weight to heavy-duty, big-capacity units. Write today for complete information.

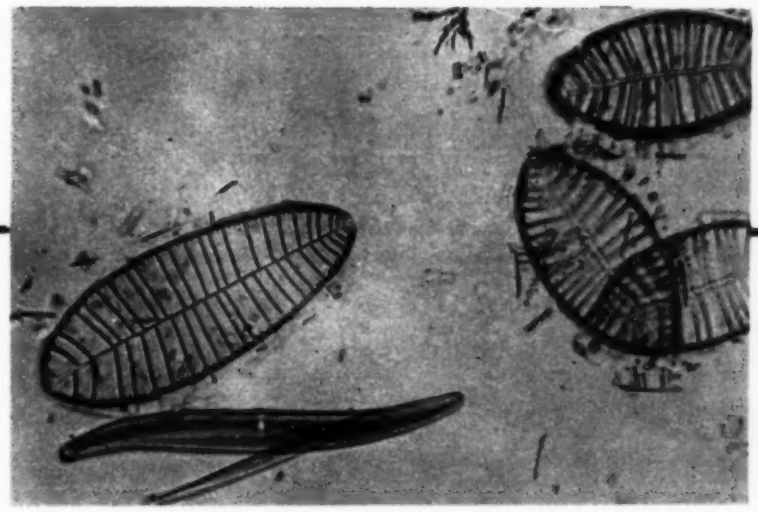
*Trade Mark

UNIVERSAL CRANE DIVISION • THE THEW SHOVEL COMPANY
LORAIN, OHIO

UNIVERSAL LORAIN MOTO-CRANE*

NO JOB TOO SMALL OR SHORT—NO JOB TOO BIG OR TOUGH

Excavating Diatomaceous Earth



PHOTOMICROGRAPH OF DIATOMS, highly magnified, the remains of which make up the "diatomaceous earth" being excavated and processed.

GENERAL VIEW of The Oromite Co.'s deposit of diatomaceous earth near Terrebonne, Oregon. All machinery and equipment are Texaco fueled and lubricated 100%.

PROCESSING PLANT for grinding, screening, and treating diatomaceous earth for use in dozens of industries as mineral fillers and filteraids.

WITH LARGE DEPOSITS of diatomaceous earth in Oregon, The Oromite Co. supplies mineral fillers for paper, plastics, rubber and hundreds of other products under the name of Dicalite.

This diatomaceous material is also an ideal filtering medium for countless liquids, including acids, chemicals, dyestuffs, foods, soaps, waxes.

All shovels, motor trucks and other equipment used in getting this material to the processing plants, as well as all equipment in the plants themselves, are TEXACO lubricated 100%.

Texaco Crater on open gears prolongs their life by reducing friction, preventing rust and corrosion. *Texaco Crater* penetrates wire rope to the core, protecting each strand against wear and weather.

Trained lubrication engineers will glady demonstrate savings with *Texaco Crater* on your wire rope and gear teeth. Phone the nearest of more than 2300 Texaco warehousing points, or write:

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The Texas Company, 135 East 42nd Street, New York, N. Y.

TEXACO CRATER BOOKLET
32 pages of where to use Crater, and how. Also are shown simple rigs for quick and easy application to wire rope. Yours for the asking.

Texaco Dealers invite you to tune in The Texaco Star Theatre — starring Kenny Baker and Frances Langford — Every Wednesday night — Columbia Network — 9:00 E.D.T., 8:00 E.S.T., 8:00 C.D.T., 7:00 C.S.T., 6:00 M.S.T., 5:00 P.S.T.

OTHER TEXACO PRODUCTS in use in this diatomaceous earth treatment plant are *Texaco* Fire-Chief *Gasoline, Insulated Havoline Motor Oil, Texaco Marfak, Texaco Thuban, Texaco Starfak Grease, Texaco Alcaid Oil, Texaco Crusher Oil.*

TEXACO CRATER

MULTIPLE MONEY-MAKER

IN THE contracting field a one-job machine is usually a part-time worker—eating into its owner's profit every day it is idle. But a machine which can do *many* things is a *multiple* money-maker . . . for when it has finished one kind of job it can tackle others.

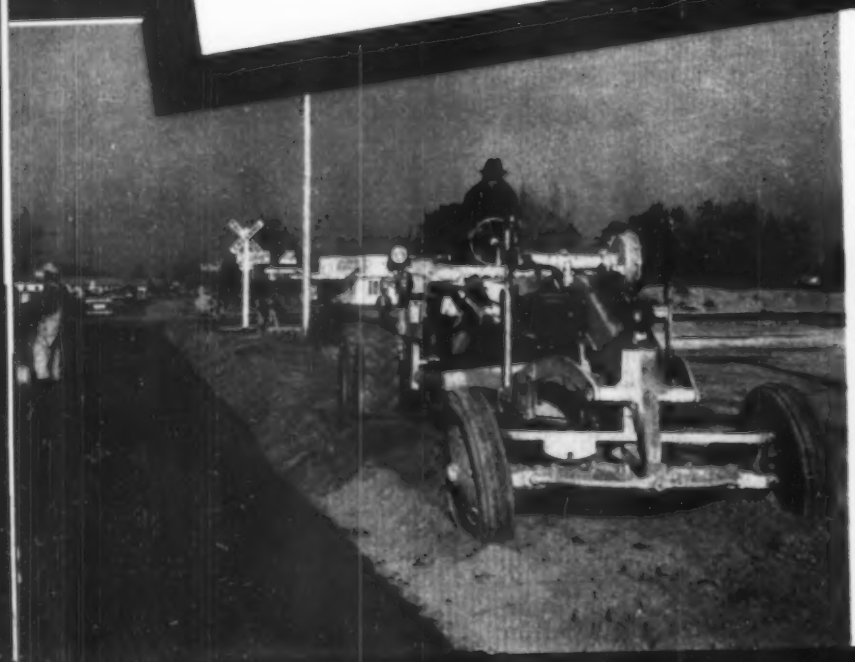
Such machines are the "Caterpillar" Diesel Motor Graders (Nos. 12 and 112), pictured here on various kinds of construction work. Through their versatility and heavy-duty capacity, they can handle main-road, airport and similar projects almost single-handed . . . make cuts and subgrades—level humps and depressions—slope banks and cut ditches—mix and spread surfacing materials—construct and maintain haul and side roads. Not only do they reduce idle-machinery losses and multiply earnings through their all-round usefulness—but they save many thousands of dollars in outlay for special equipment that would otherwise be required.

Even where extra-heavy cuts, fills and long hauls require the use of shovels, tractors and wagons, "Caterpillar" Diesel Motor Graders can be profitably employed on supplemental work (spreading, leveling and shaping) . . . to say nothing of their facility for widening, straightening, resurfacing and general maintenance work.*

• • •

* Full-revolving blade permits two-way maintenance of one-way roads without turning. Extended blade position takes care of high, steep banks and wide, deep ditches. High axle clearance enables mixing and spreading big windrows of surfacing materials. Engine weight over drive wheels gives sure-gripping traction. Powerful and dependable "Caterpillar" Diesel Engine assures steady going and big-capacity loads. Sparing use of low-cost fuel means utmost operating economy.

CATERPILLAR TRACTOR CO., PEORIA, ILLINOIS



CATERPILLAR

ABOVE "Caterpillar" Diesel No. 12 Motor Grader spreading subgrade material hauled by "Caterpillar" Diesel D8 Tractors and LeTourneau Carryall scrapers.

EXTREME LEFT "Caterpillar" Diesel No. 12 Motor Grader leveling shoulder for 12″ x 12′ concrete strips on each side of highway.

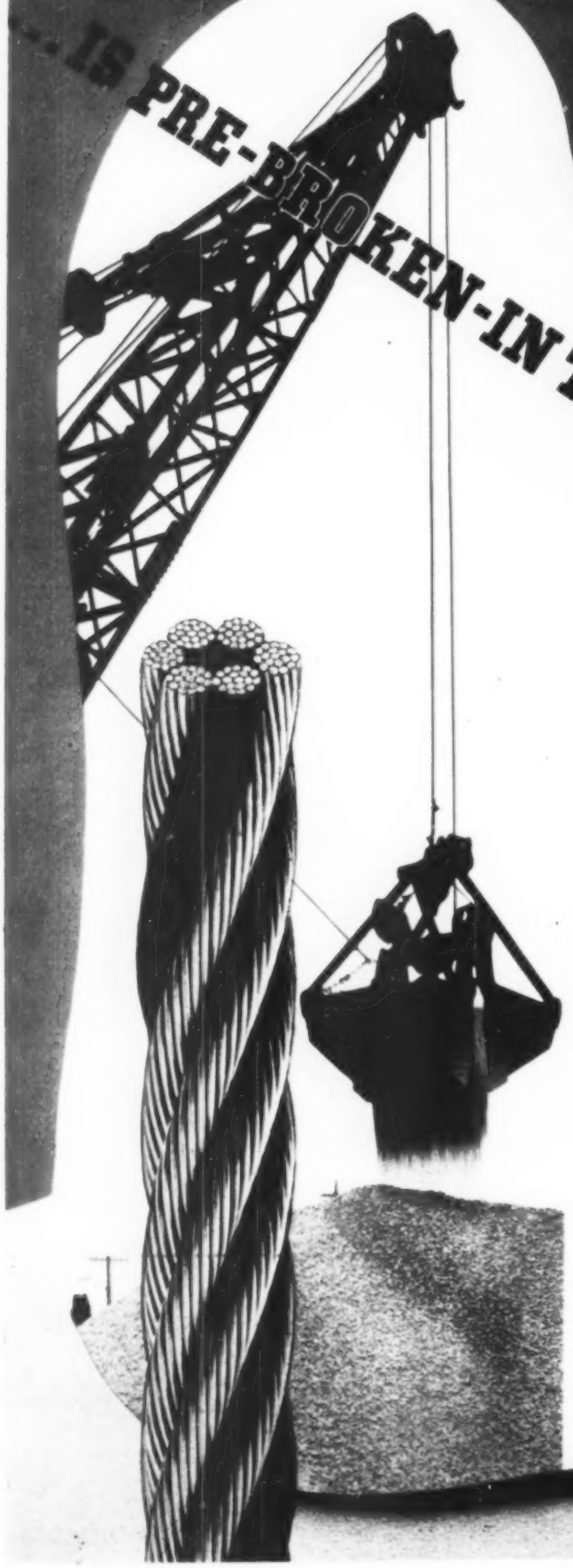
LEFT "Caterpillar" Diesel No. 112 Motor Grader building airport runways—working 8 hours per day on about 1½ gallons of fuel per hour.

HAZARD LAY-SET

Preformed

Pre-broken-in

... IS PRE-BROKEN-IN TO THE JOB



● When you put Hazard LAY-SET Preformed on the job there is no need to "baby" it until it is "broken-in." Hazard LAY-SET Preformed is preformed at the mill—pre-trained to the job.

Take this single example for instance. Closing lines on some clamshell buckets must take terrific beatings because of small sheaves and reverse bending. It is in such places that LAY-SET Preformed proves its merit right from the start.

LAY-SET has the stamina to endure the punishment *much* longer than ordinary wire rope. That means fewer shutdowns, fewer rope replacements, steadier production, greater profits.

Write today to the Hazard district office nearest you and ask for the name of your nearby Hazard distributor. He will show you how to effect real economies in your machinery operation. All Hazard ropes made of Improved Plow Steel are identified by the Green Strand—and Green Signifies Full Speed Ahead for National Preparedness.

HAZARD WIRE ROPE DIVISION

Established 1846

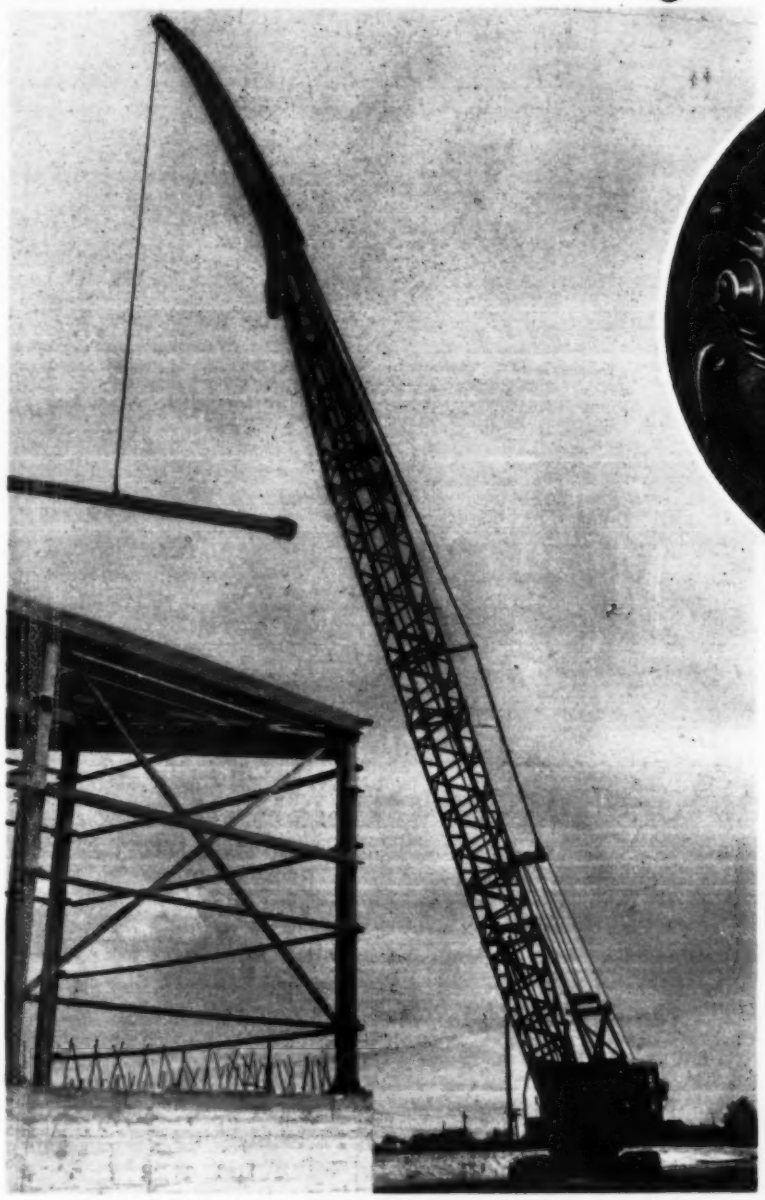
AMERICAN CHAIN & CABLE COMPANY, INC.

WILKES-BARRE, PENNSYLVANIA

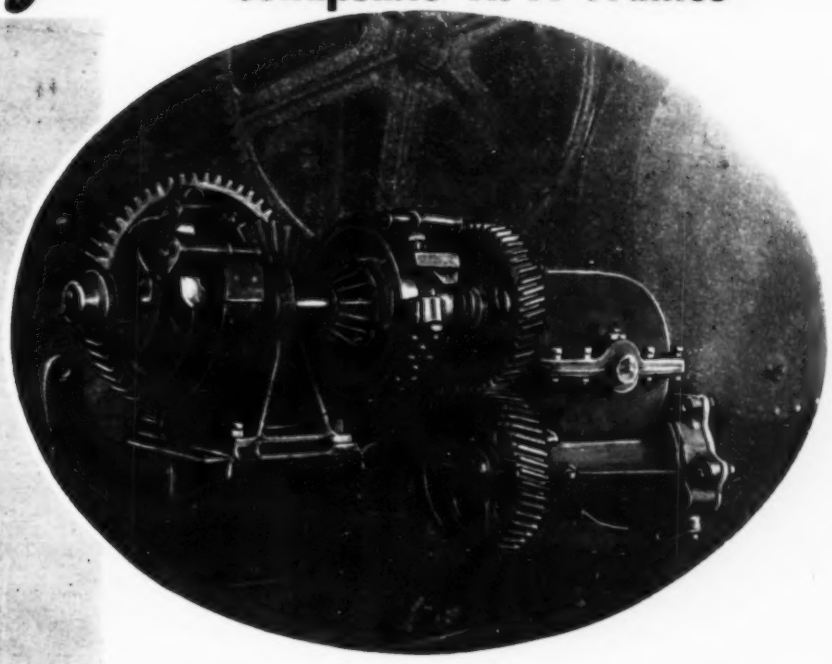
District Offices: New York, Chicago, Philadelphia, Pittsburgh, Fort Worth, San Francisco, Denver, Los Angeles, Atlanta, Tacoma

Announcing

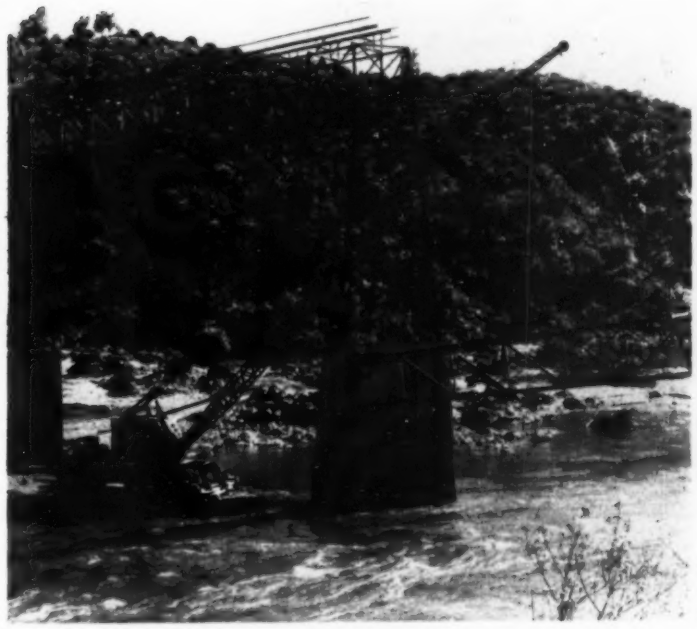
New Boom Hoist • Longer Booms
Collapsible Hi-A Frames



● Model 65 heavy-duty 20-ton crane setting steel for Austin Company on midwest industrial plant expansion using 90 feet of 110′ pin connected boom.



● Here is the new Independent Boom Hoist, with specially designed self-locking, high speed worm and worm wheel running in oil. Boom and load raised or lowered only under power providing safety and precision. Available on either crawler or truck mounted models.



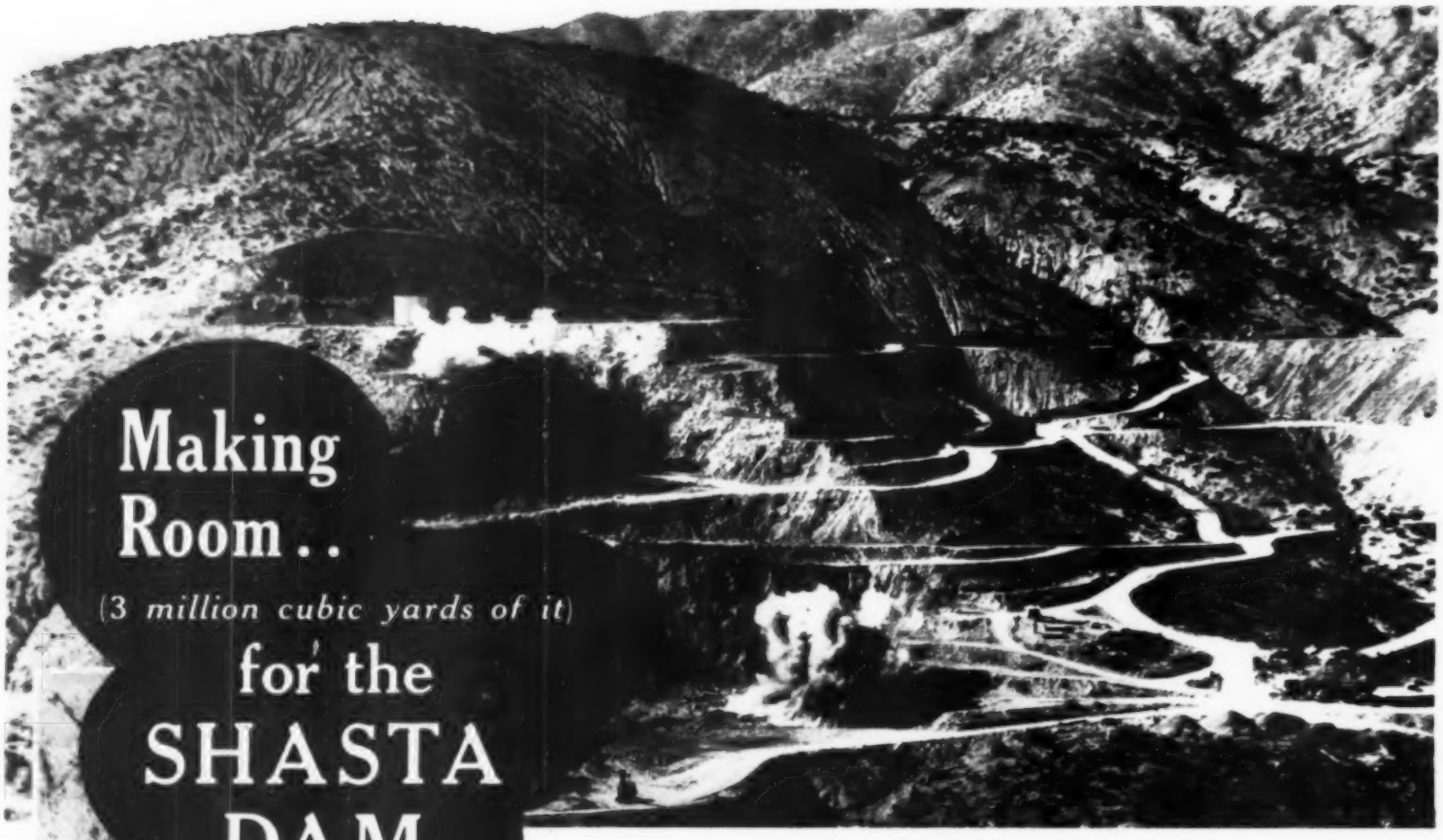
● A 6½-ton bridge span for Shasta Dam aggregate conveyor being placed over Sacramento River with a 90′ boom at 35′ radius and lifted to height of 75′. Work done by Bigge Drayage Co. with Model 18 "Special" Truck Crane.

We are now ready to serve Steel Erectors, Fabricators, Bridge Builders and others who may require heavy duty cranes (either crawler or truck mounted) to handle heavy loads on long booms, with safety Independent live boom hoist and collapsible Hi-A-Frame. Let us quote on your requirements—No obligation. At least get details by writing for Catalog (C-2)

BAY CITY SHOVELS, Inc., Bay City, Michigan

BAY CITY

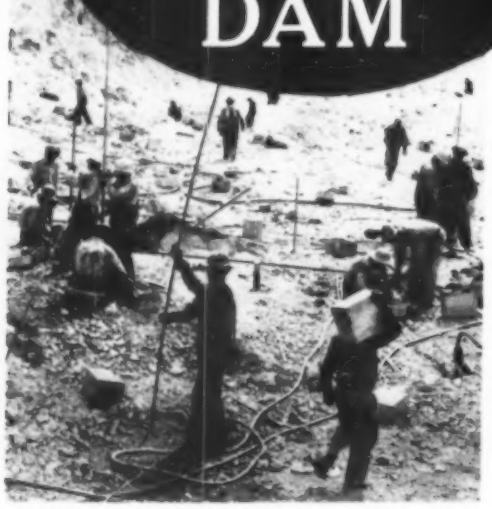
SHOVELS • CRANES • DRAGLINES • TRENCH-HOES • SKIMMERS



Making Room..

(3 million cubic yards of it)

for the SHASTA DAM



At top: Panorama showing excavation operations and general terrain.
Inset: Jackhammer crew at work.

. . . Another big construction job for ATLAS EXPLOSIVES

3,215,000 cubic yards make a whale of an excavation job. But this Shasta is *some* dam! 560 feet high and 3500 feet wide at the crest, it will be the second largest concrete dam in the world, the highest overflow type anywhere.

On a job of this size and importance, Pacific Constructors, Inc., naturally choose their supplies with the greatest care. Atlas Explosives are used exclusively. On important construction jobs across the country Atlas is doing a job of "Better Blasting."

Ask the Atlas Representative to figure with you on your next job.

ATLAS POWDER COMPANY, WILMINGTON, DEL.

Cable Address—Atpowco

Everything for Blasting

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ATLAS

EXPLOSIVES

CHEMICALS ATLAS EXPLOSIVES

Here's a Sure Way to a . . .

PROFITABLE SCRAPER BUY

1

RATE THE SCRAPER
USE THIS SCORE CARD

Consistent scraper profits naturally depend on having a good scraper to begin with. The better the scraper, the better your chances of making money with it. To help you select the best, we have developed this scraper check list. Use it as an aid to evaluating scrapers . . . for more profitable operation.

Check These Important Profit-Assuring Points	LeTourneau Rating
1 Will the scraper you are considering handle all materials—from easy loam to broken rock?	Yes, proved by thousands of jobs.
(a) Does it have a positive ejection tailgate so the bowl is completely cleaned of wet, sticky materials on every trip?	Yes, 100% positive ejection.
2 Does it operate by means of safe, fast-acting, flexible cable control?	Yes.
(a) . . . so the operator can instantly lift the blade to prevent tractor stalling when encountering rocks or stumps?	Yes, split-second control.
(b) . . . so you can operate it equally well in sub-zero weather or tropical heat?	Yes, cable is unaffected by heat or cold.
(c) . . . so you can easily interchange the tractor with such other tools as 'Dozers, Rooters and Cranes?	Yes.
3 Has it large diameter tires for light draft and flotation, and of sufficient capacity to handle heavy loads?	Yes.
(a) Is it built so extra tires can be added to give even more flotation where needed on jobs in unusually soft materials?	Yes, and without re-designing scraper.
4 Has it been job proven by customers the world over?	Yes, used in 80 countries.
5 What is the manufacturer's generally recognized position in the scraper industry?	First.
6 Can the manufacturer prove by a weight demonstration that the scraper will consistently deliver and exceed its full claimed capacity? In short—does it deliver "honest yardage"?	Yes, LeTourneau pioneered accurate "weight" tests.
7 Are sales and service facilities readily available the world over and through a well-trained dealer organization?	Yes, from "Caterpillar."
8 Is the line complete enough so I can select the right size to fit my job?	12 sizes—3 to 33 yds.—5 cutting widths.
(a) Are the big capacity models designed to take fullest advantage in pay yards of the hauling power of today's bigger powered tractors?	Yes, by pusher loading.
9 How does list price compare with other scrapers on the basis of comparable tires, blades and net cost per yard of heaped capacity?	Cheapest! But see your dealer.

2

ASK FOR JOB PROOF
Insist on a Certified Weight Demonstration

After you've checked scrapers point by point, if you're still doubtful, ask for a job demonstration. To eliminate guesswork, insist that the scraper loads be weighed. Only by accurate weight can you determine the actual pay load of a scraper. Your "Caterpillar" and LeTourneau dealer will gladly prove to you . . . by weighed loads . . . the superiority of LeTourneau Carryalls. For "lowest net cost per yard" . . . see him NOW!

For lowest net cost per yard . . .

LETOURNEAU

CARRYALL* SCRAPERS

ANGLEDOZERS*, BULLDOZERS, ROOTERS*, POWER CONTROL UNITS, PUSHDOZERS
DRAG SCRAPERS, SHEEP'S FOOT ROLLERS, CRANES, BUGGIES*, TREEDOZERS

R. G. LeTOURNEAU, INC.
Peoria Illinois - - - Stockton, Calif.
Cable Address: "BOBLETORNO"

RPM DELO keeps CHICAGO PNEUMATICS "exceptionally clean!"

When hundreds of hours of full-load engine tests prove to Chicago Pneumatic Tool Company that RPM DELO keeps its Diesels "exceptionally clean"—you, too, can bank on these four facts:

1—RPM DELO LUBRICATED engines work better—deliver top power!

2—RPM DELO LUBRICATED engines will last longer!

3—RPM DELO LUBRICATED engines will cut maintenance costs!

4—RPM DELO LUBRICATED engines will spend less time laid up for overhauls—more time on the job making money!

Chicago Pneumatic's findings back up the exhaustive lubricating oil tests of leading Diesel manufacturers. RPM DELO reduces carbon formations—eliminates bearing corrosion—ends ring sticking—keeps pistons and rings unusually free of lacquer—stops sludge trouble absolutely.

But prove all these clean-engine advantages in your own Diesels—regardless of make or size. Watch RPM DELO *down* costs, *up* profits for you!

RPM
DIESEL ENGINE LUBRICATING OIL

Order from Your Nearest Distributor as Listed Below:

IN THE UNITED STATES

RPM DELO:
The California Company (Montana only)
Humble Oil & Refining Company
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Standard Oil Company of Nebraska
Standard Oil Company of California
Standard Oil Company of Texas
Utah Oil Refining Company

Diol RPM DELO:
The Carter Oil Company, Tulsa, Oklahoma
Colonial Beacon Oil Company
Standard Oil Company of Louisiana
Standard Oil Company of New Jersey
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Standard Oil Company of British Columbia Limited

THROUGHOUT THE WORLD

RPM DELO is available through distributors in more than 100 countries.

Unequaled for every Diesel

STANDARD OIL COMPANY OF CALIFORNIA

The Importance of an Adequate *Safety Factor** For Your Wire Rope

**The Safety Factor of a rope is the number of times the rope is stronger than the load.*

Engineers explain it as "the ratio between the rated breaking strength of the rope and the load applied to the rope."

A wire rope operated with an inadequate Safety Factor is like a small man lifting a very heavy load. He may do it successfully for a period of time—but eventually he'll strain a muscle or receive a permanent injury which may shelve him for life: That kind of operation is costly. Make sure you have an adequate SAFETY FACTOR for ropes on all your loads.

HOW TO FIGURE: If a crane (having a single part line) is equipped with a rope having a breaking strength of 12 tons, and is required to lift a load weighing two tons, the Safety Factor of the rope is 6—adequate in this case (see Illustration and Table).

If the rope were required to handle a 3-ton load the Safety Factor would then be only 4—too low for safe, economical operation (see Illustration and Table).

THE VALUE OF AN ADEQUATE SAFETY FACTOR—

By allowing an adequate Safety Factor for all ropes, safe operation of your equipment is assured, longer, lower cost service is obtained from the rope. Here's why:

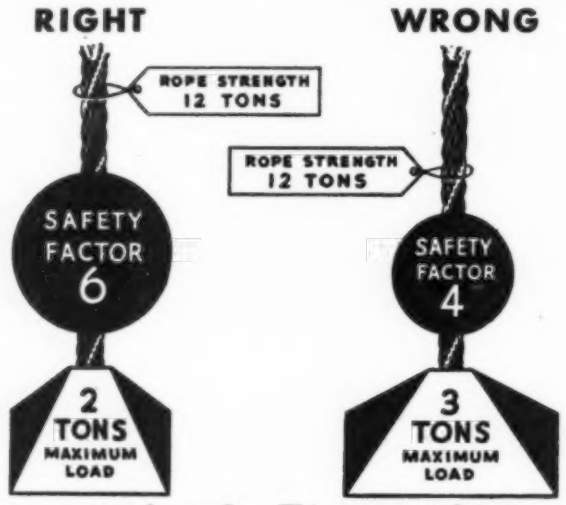
1. Overloading is prevented.
The ability of wire rope to withstand bending or fatigue decreases rapidly when loaded too heavily. This is one of the greatest causes of rope failure.

2. Service life is increased.
With a high factor of safety the pressure per square inch between the rope and sheave or drum (or other object along the path of rope travel) is less, thereby reducing the rate of wear. A wire rope with a Safety Factor of 6 will last approximately twice as long as the same rope operating with a Safety Factor of 3.

3. Safety in operation is increased.
A high initial safety factor in the rope means that after its strength is reduced by wear or broken wires that a greater reserve strength remains. This means greater protection against accidents to men and machinery.

This is NO. 4 IN A SERIES *of informative articles for wire rope users prepared by the Macwhyte Wire Rope Company*

AVOID COSTLY AND DANGEROUS OVERLOADING
. . . Make Sure You Have An Ample Safety Factor



This represents safe, profitable practice for a crane rope.

This represents dangerous, costly practice. Safety Factor is too low.

MINIMUM SAFETY FACTORS

Established After Many Years of Experience and Testing

Type of Service	Minimum Safety Factor
Guys—Derricks	5
" —Stacks	3.5
Shovels, Cranes, Excavators	5
Overhead Traveling Cranes	6
Hot Ladle Cranes	8
Electric and Air Hoists	7
Track Ropes	4
Derricks	6
Mine Shafts—Up to 500′ deep	8
500′ to 1000′ deep	7
1000′ to 2000′ "	6
2000′ to 3000′ "	5
Over 3000′ "	4
Passenger Elevators —	
Car Speeds 250′ per min.	9
500′ " "	10.25
800′ " "	11.25
1000′ " "	11.6
Miscellaneous Hoisting Equipment	5

NO. 463

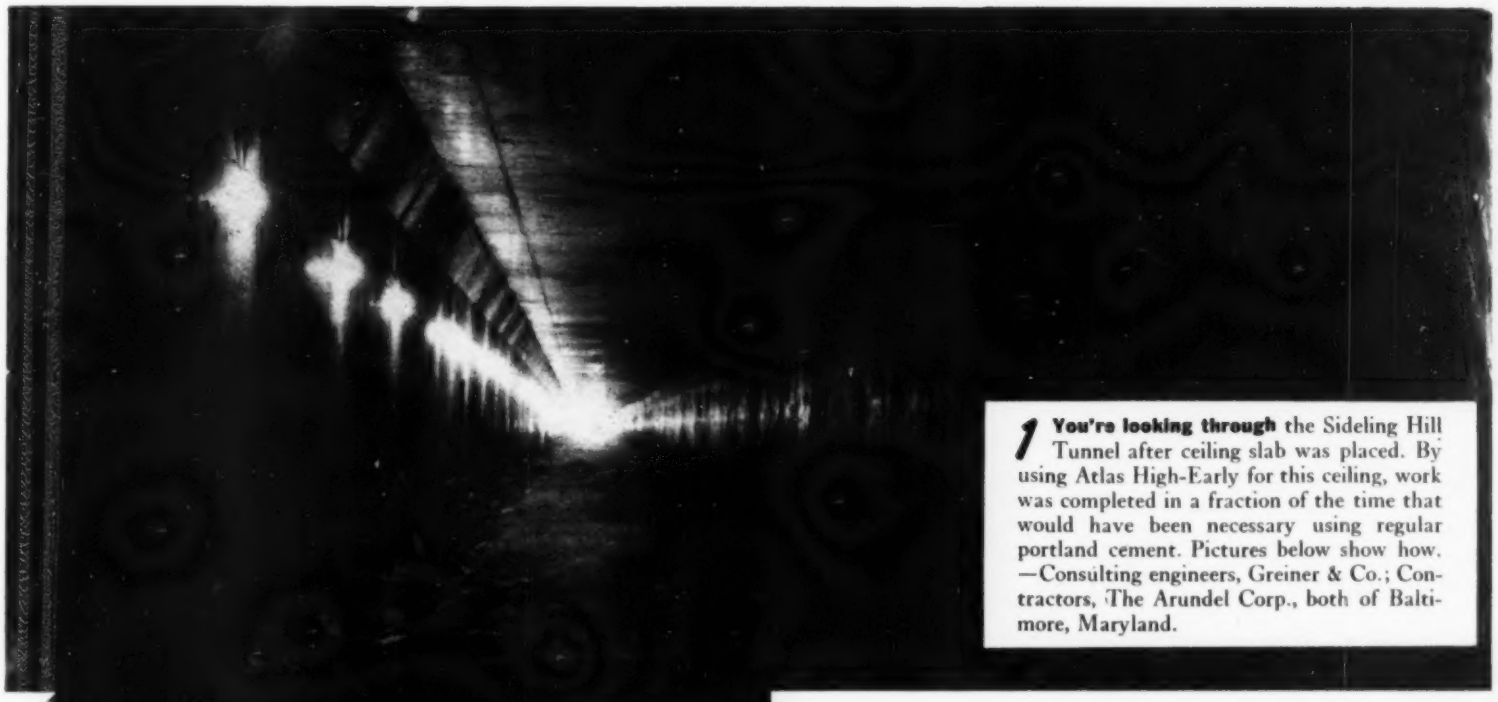
MACWHYTE ENGINEERS are always at your service to recommend the correct ropes for your needs.

Copies of this and previous articles on how to get the most out of your wire rope are available. Send us your name and title on company letterhead and copies will be sent you without obligation.

MACWHYTE COMPANY

Kenosha, Wisconsin. Manufacturers of PREformed, Internally Lubricated, Laboratory-Tested and Field-Proved Wire Rope—and Braided Wire Rope Slings.

New York . . . Pittsburgh . . . Chicago . . . Ft. Worth . . . Portland . . . Seattle . . . San Francisco. (Distributors throughout the U. S. A.)



1 You're looking through the Sideling Hill Tunnel after ceiling slab was placed. By using Atlas High-Early for this ceiling, work was completed in a fraction of the time that would have been necessary using regular portland cement. Pictures below show how. —Consulting engineers, Greiner & Co.; Contractors, The Arundel Corp., both of Baltimore, Maryland.

SIDELING HILL TUNNEL *finished faster*

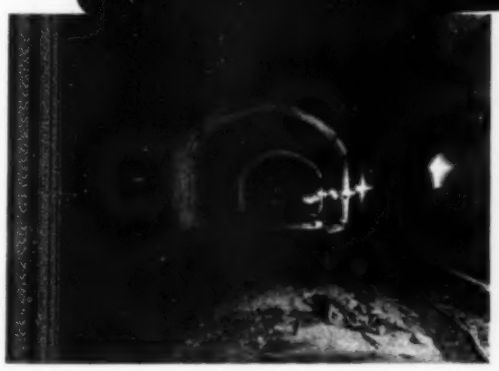
WITH AID OF

ATLAS HIGH-EARLY CEMENT

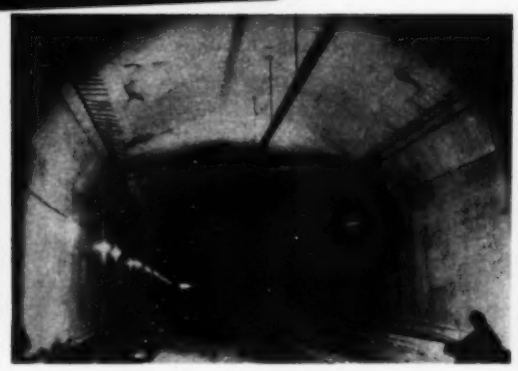
"RUSH" is the order recently given for all work on the Sideling Hill Tunnel. This is necessary to insure construction being completed in time for the scheduled opening of the great Pennsylvania Turnpike on July Fourth.

One of the most important construction speed-ups has been made in the concreting of the horizontal slab which forms a ceiling for the tunnel. Many days' time has been saved on this work by shifting from regular portland cement to Atlas High-Early—the cement that gains working strength in a fraction of the usual time. In addition to saving many hours of curing time, and speeding up stripping of forms, the use of Atlas High-Early made possible top-speed concreting with only two sets of forms instead of four.

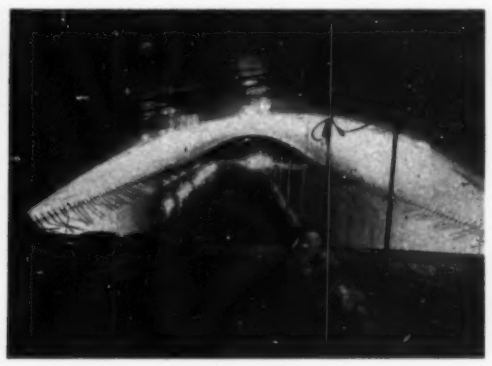
Now, you may never build a tunnel like this. But many times a year you plan or carry out concreting work which offers you similar opportunities to reap substantial time- and money-savings . . . by specifying Atlas High-Early cement. So try out this cement that gains strength so fast, on your next job. Universal Atlas Cement Co. (United States Steel Corporation Subsidiary), Chrysler Building, New York City.



2 Just before placing the ceiling slab in the Sideling Hill Tunnel, longest of the seven tunnels of the new Pennsylvania Turnpike. This tunnel is 6782 ft. long, 28 ft. 6 in. wide, and will carry two lanes of traffic. When placed, the ceiling slab turns the upper part of the tunnel into a huge air duct.



3 See how the ceiling slab was placed. The contractors cast 90 ft. slabs in alternate sections so that there was always one section open between the placing operations. The use of Atlas High-Early cement cut curing time substantially, allowed much earlier stripping of forms, and saved two sets of forms.



4 Picture taken standing on the ceiling slab. These slabs are 5 in. thick and are held up by special steel suspension rods from the center of the arch. See the intervening space between sections. Over 3,000 linear ft. of ceiling slab have been placed to date.

CM-H-17

ATLAS HIGH-EARLY CEMENT

A UNIVERSAL ATLAS PRODUCT

LOW COST

3/8 to 1/2 inch Rock

TELSMITH

INTERCONE CRUSHER

You *expect* costs to be low with a Telsmith Crusher. The Intercone cuts crushing costs to a surprisingly low figure, even for Telsmith.

But it's the *record low price* you pay—and all the extra crusher features you *get* for your money—that make the Intercone something to shout about!

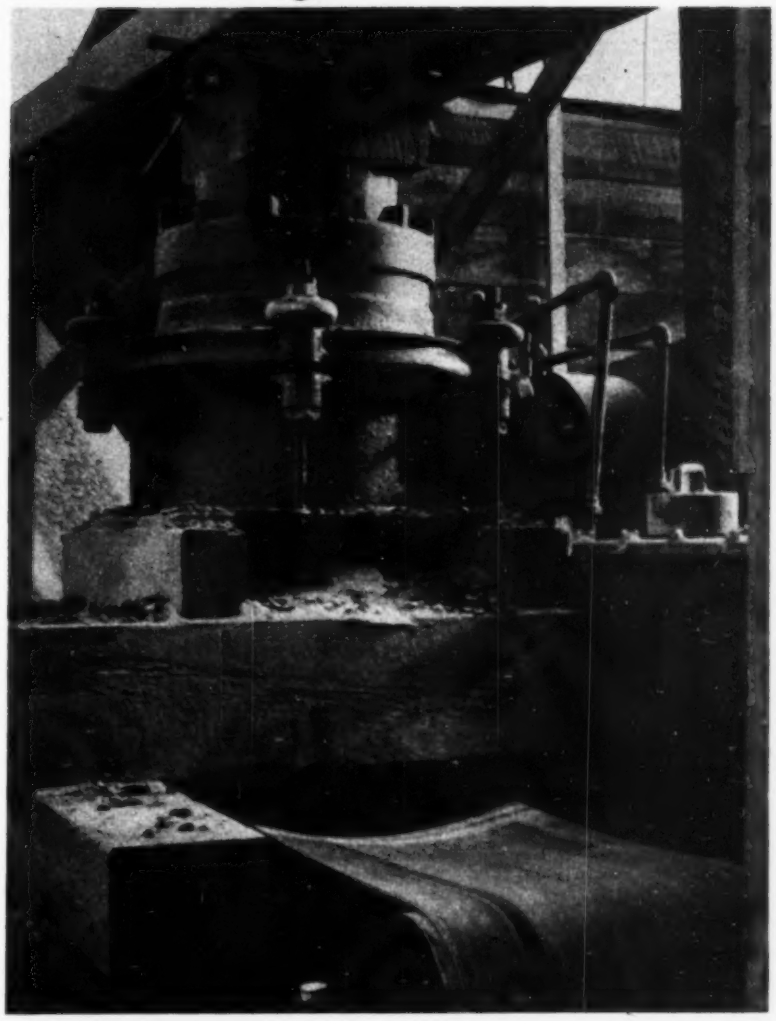
You get every *advanced* feature of crusher design! And the same superior performance and all-around dependability that has made the Telsmith line America's standard for crusher value.

You *make more money* with an Intercone on the job. With its flared head and concave, settings for ⅜ and ½ in. aggregate are easy and economical. Choke feed . . . high speed crushing by *impact* mean a larger tonnage—faster! The product is finer . . . and better!

You *save more money* with an Intercone on the job . . . operating costs are so surprisingly low. And that goes for maintenance, too. Intercone takes less power . . . less oil . . . less manganese steel. And it's positively protected against tramp iron.

Present performance is *the proof.* In plants all over the country, Intercone Crushers are setting new production and profit records for their owners.

Write for *details*—right *now*!



Lowest Price for Any Reduction Crusher of Equal Size

AND YOU GET ALL THESE FEATURES

● *big capacity* ● *wide range of fine sizes* ● *quick, easy adjustment* ● *choke feed* ● *strong steel structure* ● *lead bronze eccentric sleeves* ● *high grade alloy steel parts* ● *force-feed lubrication* ● *positive protection against tramp iron* ● *lowest headroom.*

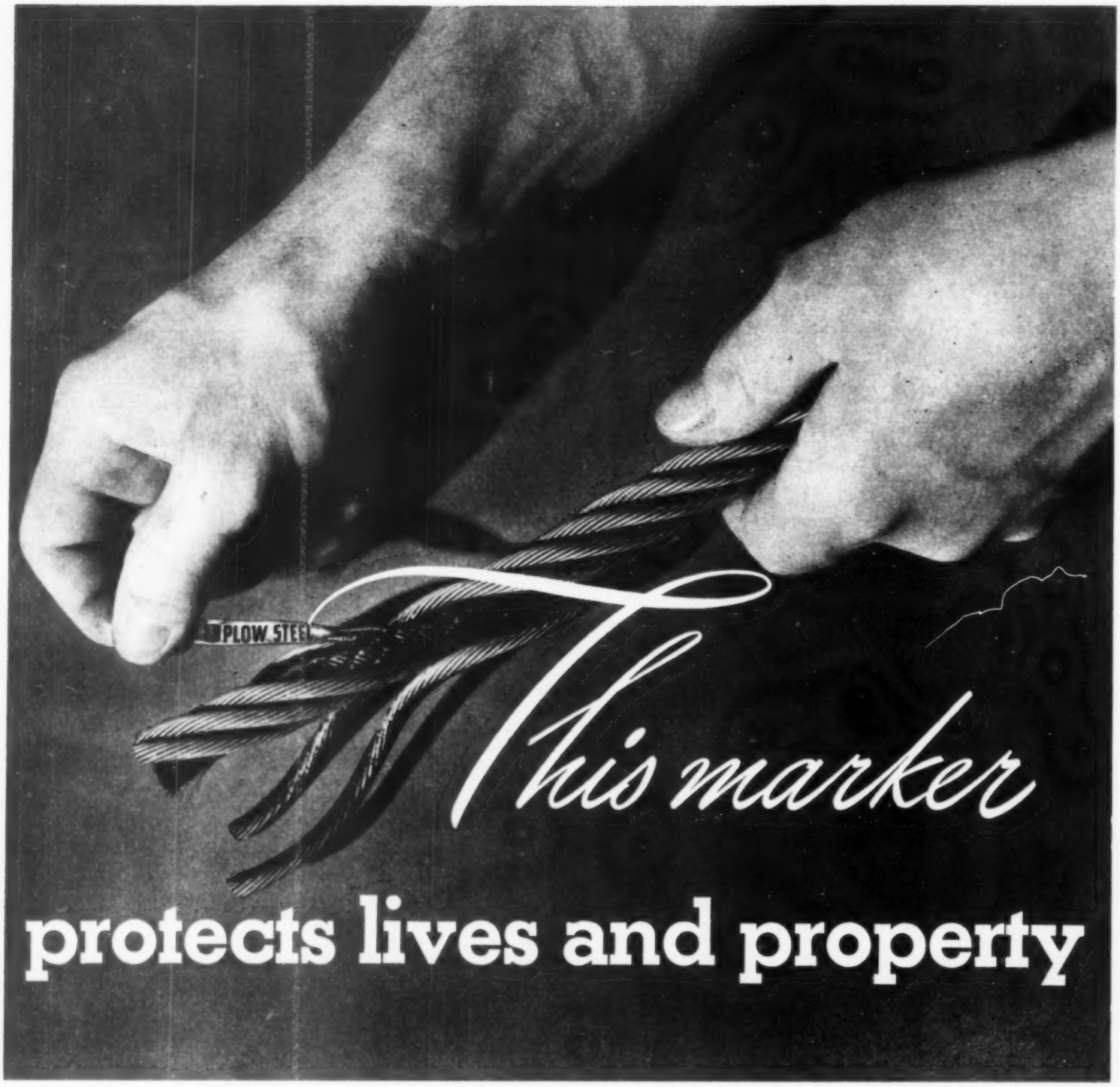
IC-2

SMITH ENGINEERING WORKS, 502 E. CAPITOL DRIVE, MILWAUKEE, WISCONSIN

Cable Addresses: Sengworks, Milwaukee—Concrete, London — EXPORT OFFICE: 770-A Hudson Terminal Bldg., New York

Samuel Osborn (S. A.) Ltd. Johannesburg, So. Africa · Armco International Corp. Buenos Aires, Argentina · Eng. Equip. & Supply Co. Manila, P. I. · 50 Church St. New York City · 211 W. Wacker Drive Chicago, Ill. · Mines Eng. & Equip. Co. San Francisco, Calif.

Canadian Vickers, Ltd., Montreal · Gordon Russell, Ltd., Vancouver · General Agents for Western States: Mine & Smelter Supply Company, Denver, Salt Lake City, El Paso



An exclusive identification tape is built into every foot of Bethlehem Wire Rope. This tape—known as Telfax—is clearly marked with the grade of steel in the rope. As a double check, each tape bears a distinctive color—purple—Purple Strand; green—Plow Steel; red—Cast Steel, and so on.

Telfax tape is a positive protection for workmen and property. It eliminates the possibility of using the wrong grade of rope on a dangerous or critical job.

Telfax tape is laid next to the core. Regardless of whether the rope has been respooled or comes to you in cut lengths, with all markings lost, you can check it quickly and easily with the Telfax identification tape.

BETHLEHEM STEEL

BETHLEHEM STEEL COMPANY

MOST POWER
when it's *most needed*

CHEVROLET TRUCKS

With Valve-in-Head Engines Have Maximum Power at *Usable* Speeds

Chevrolet trucks lead in sales because so many truck users are convinced that Chevrolets are the best buy. That is, Chevrolet trucks lead because they have the most desirable balance of power, economy and durability—power to do the job well, economy to do the job at low cost, durability to stay on the job.

Chevrolet trucks owe their superiority in power, economy and durability largely to the fact that they have Valve-in-Head engines. That's why the Chevrolet truck engine excels others of its size—and even larger and costlier engines—in that most important of all truck engine qualities: *high pulling power, or torque, at low engine speeds.*

You don't have to "race your engine" when you need a lot of pulling power in a Chevrolet. This Valve-in-Head engine develops its top torque of 168 lb. ft. at only 1100 r.p.m.—a greater maximum torque than a larger "8" develops when whirling at 2000 r.p.m., and only 2 lb. ft. less than the maximum that a still larger and much costlier "8" develops when spinning at 2100 r.p.m. Highly important to the truck user also is another advantage of the Chevrolet Valve-in-Head design, the fact that this engine develops high torque over an extraordinarily wide range of engine speeds—160 lb. ft. or more all the way from only 600 r.p.m. up to 2000 r.p.m.

That's power for you—high power at low engine speed—maximum power at usable road speed—*most power when you need it most.*

Valve-in-Head means Ahead in Value

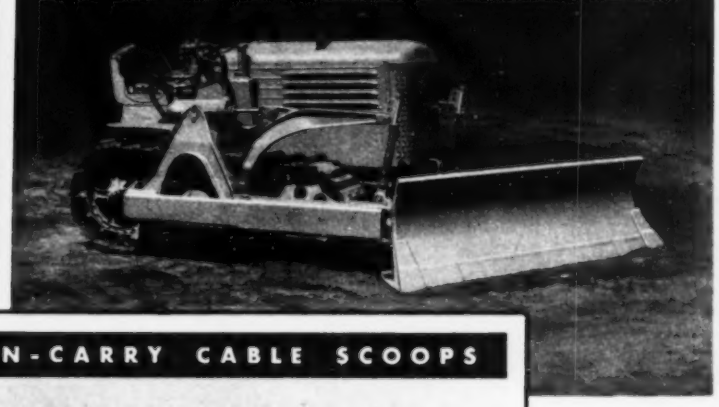
When you have to *race* an engine to get top power, fuel and oil costs go up and engine life is shortened. That explains why the Chevrolet Valve-in-Head engine, besides giving the most power when it is most needed, surpasses also in economy and in durability. Remember—*Valve-in-Head means Ahead in Value.*

CHEVROLET MOTOR DIVISION, *General Motors Sales Corporation*, DETROIT, MICHIGAN

Greater Profits FOR YOU IN 1940 WITH HEIL ROAD MACHINERY

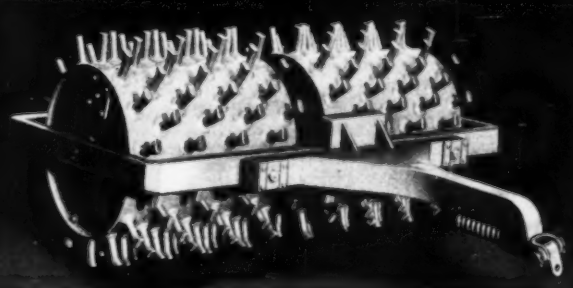
BH-315—HEIL HYDRAULIC DUMP UNITS

RM-390—HEIL HYDRAULIC TRAIL-BUILDER



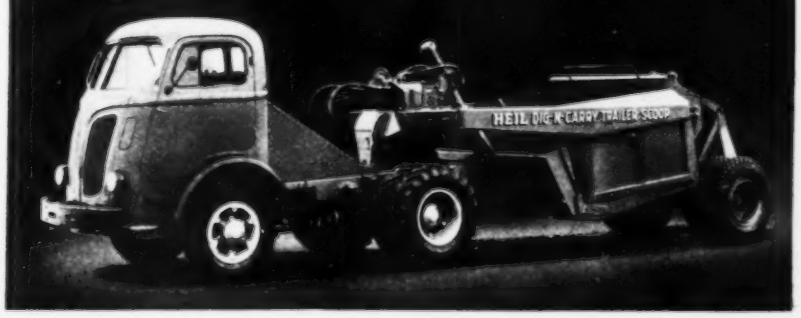
HEIL DIG-N-CARRY CABLE SCOOPS

RM-107—HEIL SHEEPSFOOT TAMPING ROLLERS



RM-169—HEIL DIG-N-CARRY HYDRAULIC SCOOPS

RM-242—HEIL DIG-N-CARRY TRAILER-SCOOPS



The COMPLETE HEIL LINE INCLUDES the RIGHT UNITS to handle your jobs PROFITABLY

Field experience proves that contractors using dependable Heil Road Machinery can bid low to get good jobs and yet make money — Modern, up-to-the-minute Heil design and Heil Quality construction gives you equipment that has the "guts" to see jobs through on time — Equip yourself for profits with Heil Road Machinery—Send today for free catalog—Address:

THE HEIL CO.

MILWAUKEE, WISCONSIN

HILLSIDE, NEW JERSEY

Have you seen the 1940 MULTI FOOTE 27E?

ENCLOSED GEARS!

WIDER, FASTER SKIP!

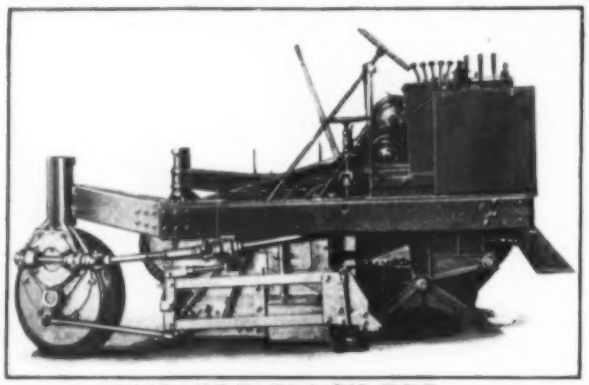
HIGH OPERATING PLATFORM!

POWERFUL FRAME!

DOUBLE CONE DRUM!

LONG BOOM!

LONGER, STRONGER CRAWLERS!



AND FOR BLACK TOP—
THE ADNUN BLACK TOP PAVER

RUGGED, dependable construction for long, hard service ● Power Cut-off—no tag end run outs ● Power to handle the heaviest truck ● Hydraulic Controls ● Continuous Course Correction—levels out surface irregularities, produces smoother pavements ● Overlapping Action Cutter Bar—makes perfect joint under pressure ● Full adjustment for bank and wedge courses ● Capacity to over 1000 tons a day ● Will NOT bring fats to the top—no slippery, unsafe surfaces.

For better work at lower cost, put an Adnun to work on your next Black Top job. Write for a catalog.

IF you want the latest in paver design, the latest in speed, the greatest possible ease of upkeep, don't fail to investigate the improved 1940 MultiFoote 27E! It has *all* the proved MultiFoote advantages *plus* new features that make it better than ever—the outstanding paver of today!

Improved crawler design—fully enclosed crawler transmission—longer crawlers for greater stability with the new long booms—improved, wider skip that's heavy enough to take any dual-tired truck in today's jobs—powerful—heavily braced frame—these and many other features make the improved MultiFoote a machine you'd regret not knowing about. A complete descriptive catalog is available now. Write for your copy *today!*

THE FOOTE CO., INC. **Nunda, N. Y.**

MULTIFOOTE

"Yes sir! Our worries ended the day we began specifying U·S·S Concrete Reinforcing Bars. No matter where the job is, there is usually a U·S·S distributor near at hand. And he gets the bars to us on time. That means plenty when we have a schedule to beat — or a stretch of favorable weather.

"Those fellows hardly ever get caught short either. They carry ample stocks of all standard sizes. If we need any cutting or bending done they do it to our specifications before delivery.

"We know we are getting good bars too. That little -N- on every bar means it conforms to the standard specifications of the Concrete Reinforcing Steel Institute — made right here in the U.S.A. of new billet steel. And their cost is low.

"If you want real quality, and in a hurry, try U·S·S Concrete Reinforcing Bars on your next job."

Order bars that bear the symbol of the Concrete Reinforcing Steel Institute. This symbol assures you top quality bars, of domestic manufacture, rolled from new billet steel.

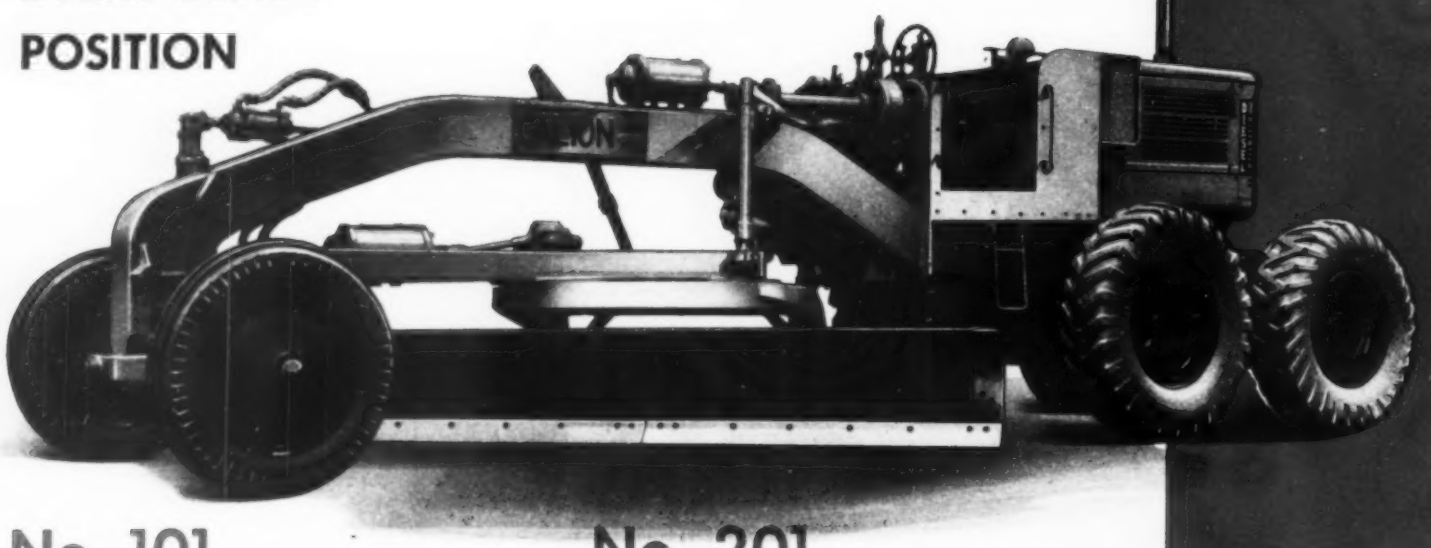
U·S·S CONCRETE REINFORCING BARS

Manufactured by
CARNEGIE-ILLINOIS STEEL CORPORATION, *Pittsburgh and Chicago*
COLUMBIA STEEL COMPANY, *San Francisco*
TENNESSEE COAL, IRON & RAILROAD COMPANY, *Birmingham*
United States Steel Export Company, New York

UNITED STATES STEEL

3 OUTSTANDING GRADER VALUES

FOR ANY CONDITION— EVERY BLADE POSITION



No. 101

Equipped with either a 66½ HP diesel or 64 HP gasoline engine, the Galion No. 101 motor grader (illustrated) is designed for the heaviest kind of blading work in new construction and maintenance. Furnished with tandem drive *only*.

Full reversible blade permits adjustment to every angle . . for flat-bottom ditching, forming V-shaped ditches, trimming shoulders, bank-cutting, and for working in reverse gear when necessary. Hydraulic control and other important features to provide low-cost and dependable performance.

Bulletin No. 253

No. 201

Identical in design and construction to the No. 101 except for power, weight and tire equipment . . the Galion No. 201 grader is equipped with a 50 HP diesel or 46 HP gasoline engine . . single or tandem drive. Like the No. 101, it has every feature necessary for economical operation day after day.

Both graders can be supplied with such attachments as: scarifier, bull dozer, roller, planer and fully enclosed deluxe cab if desired. The No. 201 also has hydraulic control and a wide range of blade adjustment.

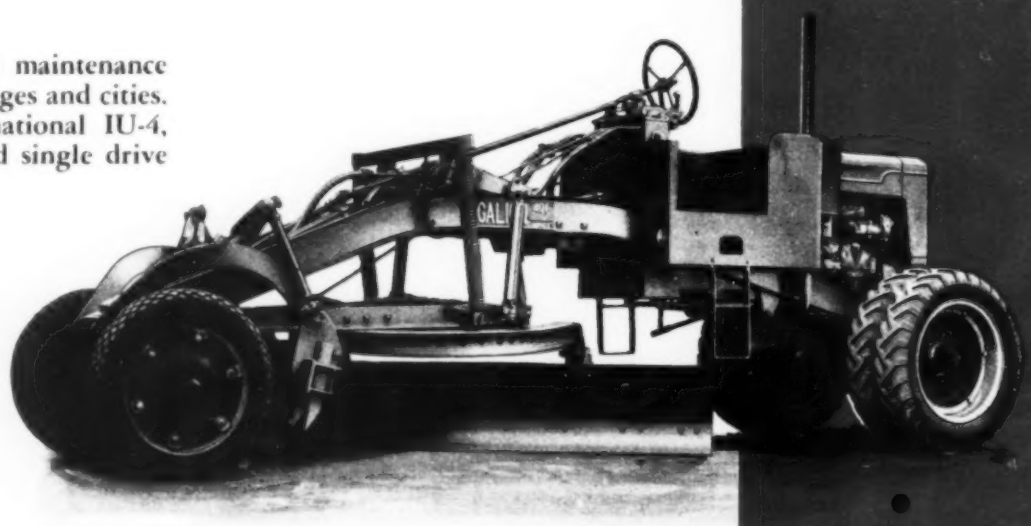
Bulletin No. 254

No. 401

A lightweight unit for general maintenance work in townships, counties, villages and cities. Equipped with a 31 HP International IU-4, four-cylinder gasoline engine and single drive *only*.

Engine is mounted over rear axle to provide the utmost in vision and traction. Has hydraulic control and many features to insure low-cost maintenance day after day. Available with full enclosed cab if desired. You'll like this light weight, economical No. 401 Grader.

Bulletin No. 255



Do You Know

that Galion builds the most complete line of road rollers to be found anywhere: 3-wheel, tandem, portable, trench and sheepsfoot . . in a weight and size to meet any compaction requirement.

Motor graders
Pull graders
Road rollers
Spreaders
Grader blades
Bull dozers
Scarifiers

The Galion Iron Works & Mfg. Co.

***Main Office and Works:* GALION, OHIO**

● ***DISTRIBUTORS EVERYWHERE***

IT TAKES A LORAIN TO STOMACH ROCK LIKE THIS

Run your experienced eyes over this rock job, Mr. Contractor. It's a bruiser from start to finish but a swell spot to test a shovel's guts. Strains, stresses, jolts and jars—you get them all in one big, continuous dose, here, and the machine that can take it and come back for more is capable of socking its dipper into any kind of digging, anywhere.

Does a Lorain qualify on this basis? Again your eyes will give you the answer. Notice how this shovel has cuddled right up to the rock face. It isn't waiting for the material to be delivered in easily digested chunks. It's right in there slugging it out with the toughest digging—and from all indications "The Rock" is on the ropes.

Write today for booklet titled "The Rocky Road to Success." It outlines the features of Center Drive design that put new power, strength and speed into shovel operation—lays more evidence right on the line to prove that Lorains will move rock profitably in every shape and form.

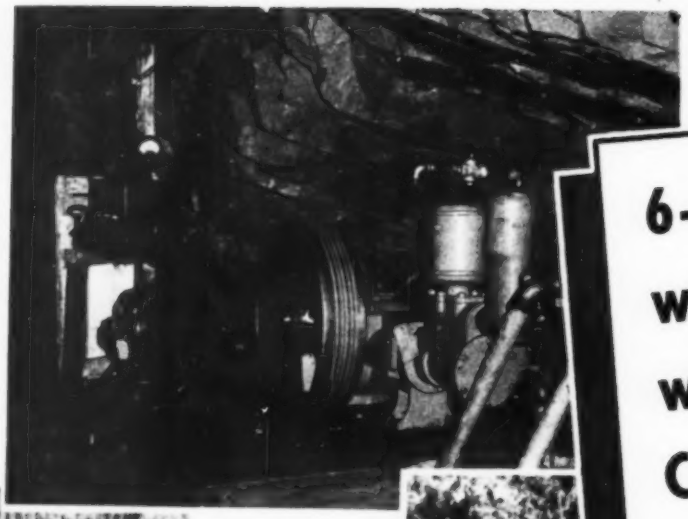
THEW CENTER DRIVE

THE THEW SHOVEL COMPANY
LORAIN, OHIO

LORAINS 19 MODELS 3/8 to 2 1/2 YDS.

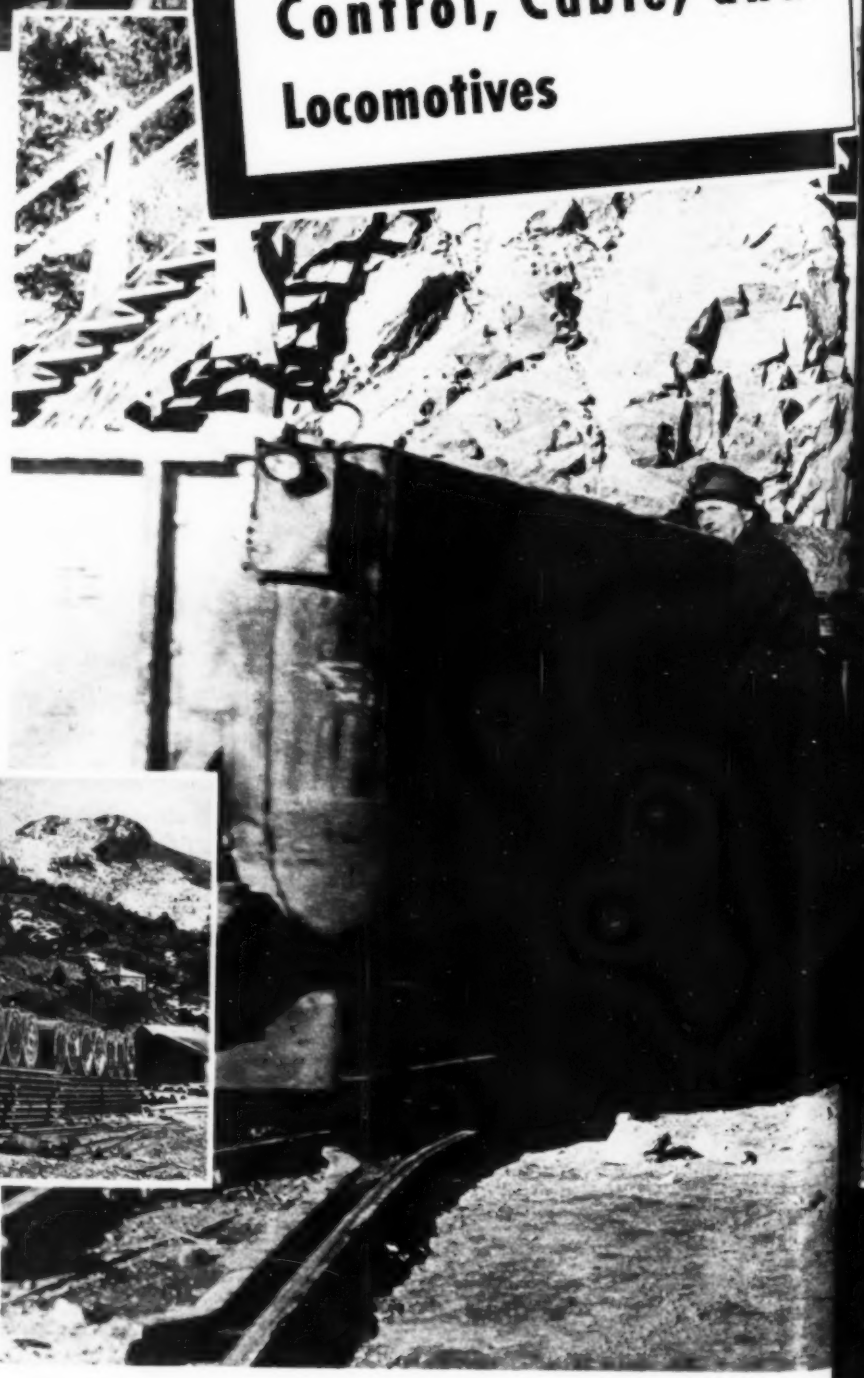
1879 FEET THROUGH GRANITE

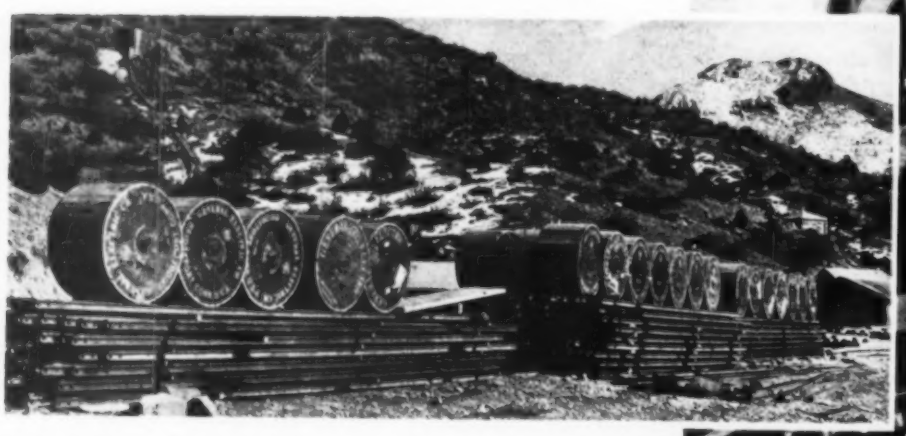
6-mile Tunnel to Underwater Mountains — Dug, with Help of G-E Motors, Control, Cable, and Locomotives



WATER FOR THE ROCK DRILLS is supplied by a pump powered by this 30-hp 900-rpm G-E motor. This is a permanent installation and will be in use as long as work is being done in the tunnel.

AUTOMATIC CHARGING of the batteries on the G-E storage-battery locomotives is accomplished with this G-E control panel in the compressor house.





HIGH-VOLTAGE CABLE must be used as the tunnel has only one entrance, and parts of the drilling must be done six miles from the power supply. Here is some of the 3-conductor, size No. 4, 3,000-volt abrasion- and water-resistant G-E cable in use.

IN WORLD'S RECORD TIME

Contractor Sets Daily, Monthly Records at Carlton Tunnel with G-E EQUIPMENT

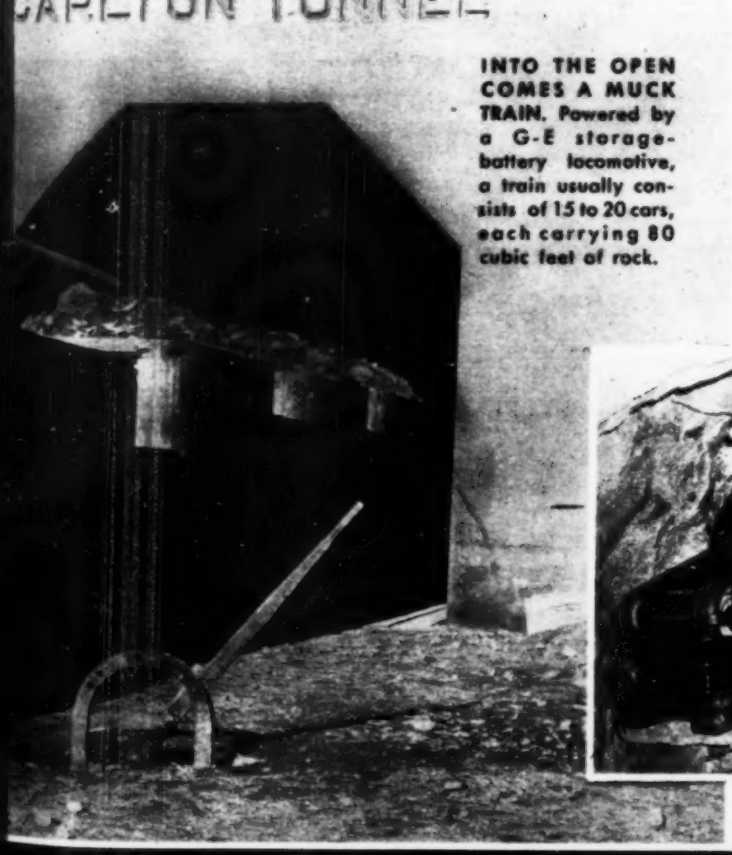
FAR into the rich Colorado mountains, drilling crews are boring through granite to dig the 6-mile Carlton Drainage Tunnel for the Golden Cycle Corporation. Cutting at a steady rate of more than 1500 feet a month, they have tunneled 74 feet in one day and 1879 feet in a 31-day month, setting world's records with each accomplishment.

When the tunnel is finished, more than two million cubic feet of rock will have been removed to unwater the Cripple Creek mining district, which will lower the working level of the famous mine 1100 feet. The new tunnel will make workable a large area of rich ore which should add 20 to 25 years to the life of the district.

Completion Date Advanced

G-E mine locomotives, motors, control, and cable are used in all phases of the drilling. Speedy, reliable performance has helped bring about advancement of the completion date.

When you're planning the electric equipment on your next job, you will do well to contact the nearest G-E office for help. Our sales engineers will recommend equipment whose speed and dependability will save days and dollars for you. General Electric Company, Schenectady, New York.



INTO THE OPEN COMES A MUCK TRAIN. Powered by a G-E storage-battery locomotive, a train usually consists of 15 to 20 cars, each carrying 80 cubic feet of rock.

FIRING THE POWDER in the heading of the tunnel is done from the storage batteries on the G-E locomotives. This photograph was taken 8500 feet from the portal of the tunnel.

IN COMES THE FRESH AIR, OUT GOES THE FOUL. This 75-hp, 1800-rpm G-E motor drives the booster ventilating fan.

GENERAL ELECTRIC

655-6A

MAKE MORE MONEY THIS WAY

on drainage and sewerage jobs

Armco catchbasins, manholes and many other fittings are prefabricated to save you time and money. They're delivered to the job ready for easy installation.

● It is no trick to keep on schedule when you use Armco Corrugated Metal Pipe for drainage and sewerage contracts. Because it is easy to handle and install in any kind of weather you can speed work and avoid costly delays. This means money in your pocket.

Remember, Armco Pipe is easily installed by unskilled labor. Ordinary care in preparing a foundation assures accurate grade and alignment. Strong, tight connections are quickly made with simple tools. No costly "curing" is needed; and no protection or heating during construction in cold weather.

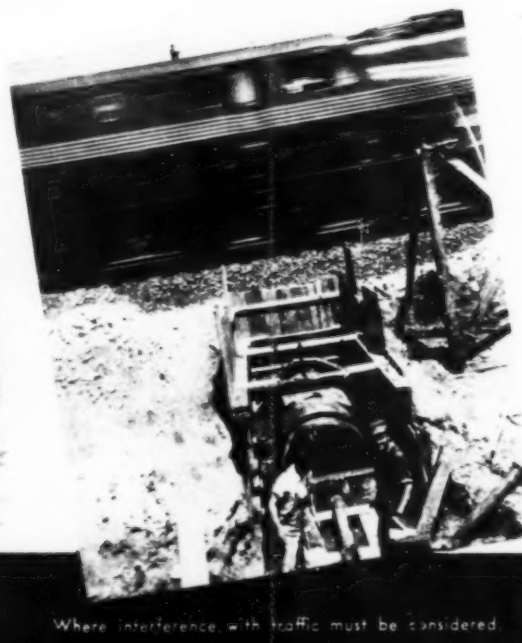
The flexible corrugated design of Armco Pipe provides ample strength without excessive weight. Long lengths (20 to 30-foot) can safely be handled without heavy equipment. Transportation costs are low. These longer lengths mean fewer joints, less assembly work. And there is little chance of damaging Armco Pipe in handling, thus eliminating time lost in replacing sections.

Try Armco Corrugated Metal Pipe on your next job. This way you'll keep ahead of schedule, under the estimate, and make more money on the job. Ask the Armco man to give you prices and complete information. Or write directly to Armco Drainage Products Association, 502 Curtis Street, Middletown, Ohio.

ARMCO
CORRUGATED
METAL PIPE

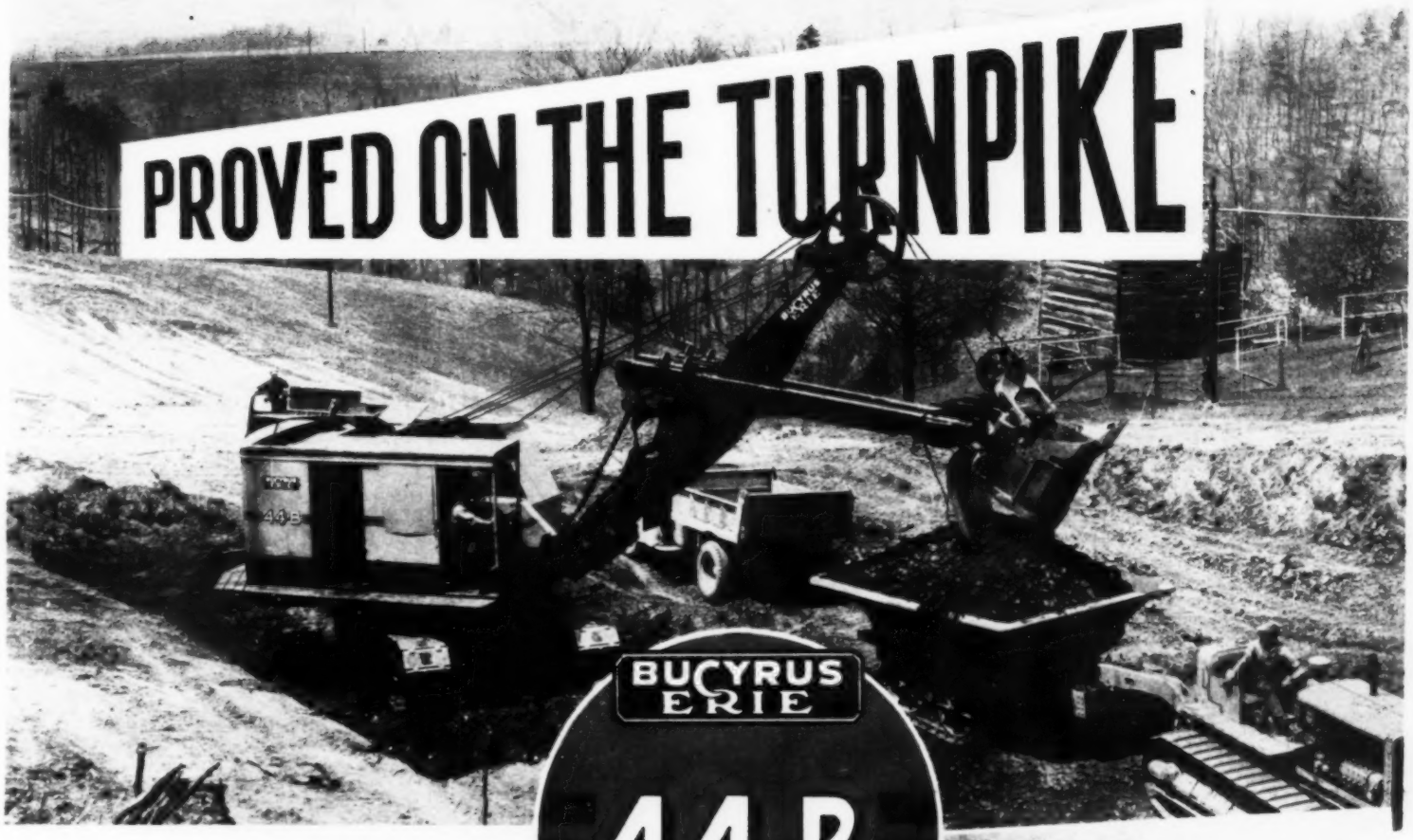
PLAIN GALVANIZED • BITUMINOUS PAVED AND COATED

Long sections of Armco Pipe are easily handled with only ropes and plank skids. Winter weather can't stop installation.



Where interference with traffic must be considered you can install pipe under railroads, highways and street intersections by Armco's simple jacking method.

PROVED ON THE TURNPIKE



The 2-yard Bucyrus-Erie 44-B proved its mettle under the high-speed heavy-duty digging requirements of the Pennsylvania Turnpike. Today, it is adding further proof on tough dragline, shovel and crane jobs the country over. The 44-B can handle the tough ones for you because it is built up to quality specifications. If you are in the market for a 2-yard excavator, investigate the 44-B. Its performance record is evidence of what it can do for you.

Bucyrus·Erie

SOUTH MILWAUKEE, WISCONSIN

FROM THE DAILY REPORT OF A TIGER BRAND WIRE ROPE ENGINEER

I was just walking into Mr. Brown's office when one of his engineers called this morning.

"My advice to you," he said on the phone, "is use Excellay. No other rope can touch it. Next time the Tiger Brand Engineer comes in I'll have him see you. He's helped me out dozens of times."

Then he looked up and saw me "Well," he said, "speak of the devil and there he is." The three of us went over the specifications together, and decided that Brown was right -- Excellay will do the best all-round job.

Yours,

Jim

KNOWING wire rope from A to Z—how to choose it and how to use it—that's the job of the American Tiger Brand Wire Rope Engineers. It will pay you to make use of their specialized knowledge and experience, gained through years of practical service to wire rope users in every industry, everywhere.

These men do more than help you select the right rope for a given application. If for any reason you are not getting full performance, they can help you locate the trouble and suggest practical ways and means for eliminating the difficulty. Get to know the American Tiger Brand Wire Rope Engineer who contacts you. Discuss your wire rope problems with him. Get his advice on every wire rope specification.

He can help you get a full dollar's worth of performance out of every dollar you invest in wire rope.

USS

EXCELLAY
Preformed
WIRE ROPE

AMERICAN STEEL & WIRE COMPANY
Cleveland, Chicago and New York

COLUMBIA STEEL COMPANY
San Francisco

United States Steel Export Company, New York

UNITED STATES STEEL

CRAWLER TROUBLES?

I'd Forgotten About Them!

Frankly, one reason so many contractors are buying P&H's is to get these tractor-type crawlers. There are other reasons, but relief from that constant "fixin' up" of crawler tracks makes a big hit. No matter whether you're in rock, sand, gravel or knee deep in muck, the track is kept at proper tension by compensator springs. You move smoothly, just like a tractor. If you ever want to replace a shoe, you simply remove four bolts, without disturbing the crawler belts . . . and these rolled steel shoes cost only a fraction of ordinary traction treads. Tractor-type crawlers are used on all P&H excavators up to 1½-yds. capacity.

The P&H Model 100, shown above, is a fast-moving, fast-digging, ⅜-yd. excavator, ideal for handling a wide range of work. It's powered by the husky Ford V-8 engine and convertible for 7 types of service with simple attachments of alloy steel. It's described in Bulletin X-18.

P&H excavators are built in 18 different sizes, from ⅜ to 5 cubic yards capacity — gasoline, Diesel or electric power. Literature is available on all models.

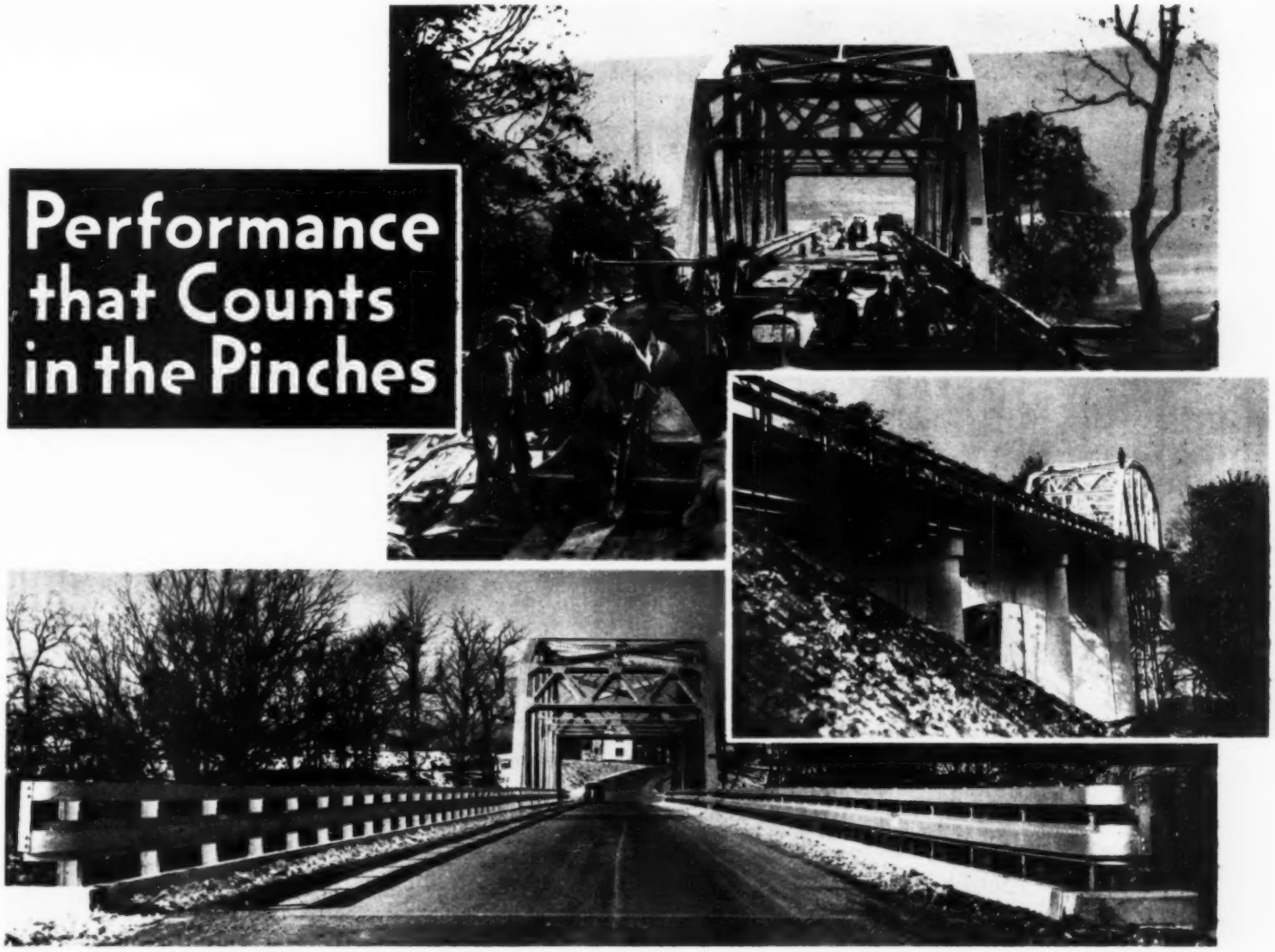
P&H EXCAVATORS

General Offices: **4494 West National Avenue, Milwaukee, Wisconsin**

HARNISCHFEGER CORPORATION

EXCAVATORS • ELECTRIC CRANES • ARC WELDERS — P&H — HOISTS • WELDING ELECTRODES • MOTORS

Performance that Counts in the Pinches



BRIDGE OVER GREAT CACAPON RIVER
Morgan County, W. Va.
OWNER:
West Virginia State Highway Commission
CONTRACTOR:
Roanoke Iron and Bridge Co., Roanoke, Va.

MEETING emergencies—making up lost time—speeding up construction to meet demands for quick completion. These are everyday construction problems. Construction skill and materials which give dependable and unusual service count in these pinches. The results obtained by the Roanoke Iron and Bridge Company with Lehigh Early Strength Cement are typical of its everyday performance in meeting emergencies.

Floods had wrecked a temporary bridge. Rush the new bridge to completion or rebuild the temporary structure? Speed had to determine the choice, for traffic restoration was imperative.

Plans were for normal cement concrete in the new bridge deck. But, by switching to Lehigh Early Strength Cement, it was completed and opened to traffic only two days after pouring the concrete—long before the temporary bridge could have been built. Incidentally the contractor saved $5000—the cost for restoration of temporary bridge and prolonged construction time.

LEHIGH EARLY STRENGTH CEMENT

Because Lehigh Early Strength Cement in 24 to 48 hours equals the strength of normal cement at 7 days, it produces service strength concrete 3 to 5 times faster. This quick strength counts in emergencies—it has other advantages. It reduces form costs by quick removal and reuse. It helps co-ordinate schedules; shortens construction time; reduces overhead. In cold weather it cuts heat protection cost by a half to two-thirds. And Lehigh Early Strength Cement makes better, denser concrete.

The Lehigh Service Department will gladly answer your inquiries.

LEHIGH PORTLAND CEMENT COMPANY

Allentown, Pa., Chicago, Ill., Spokane, Wash.

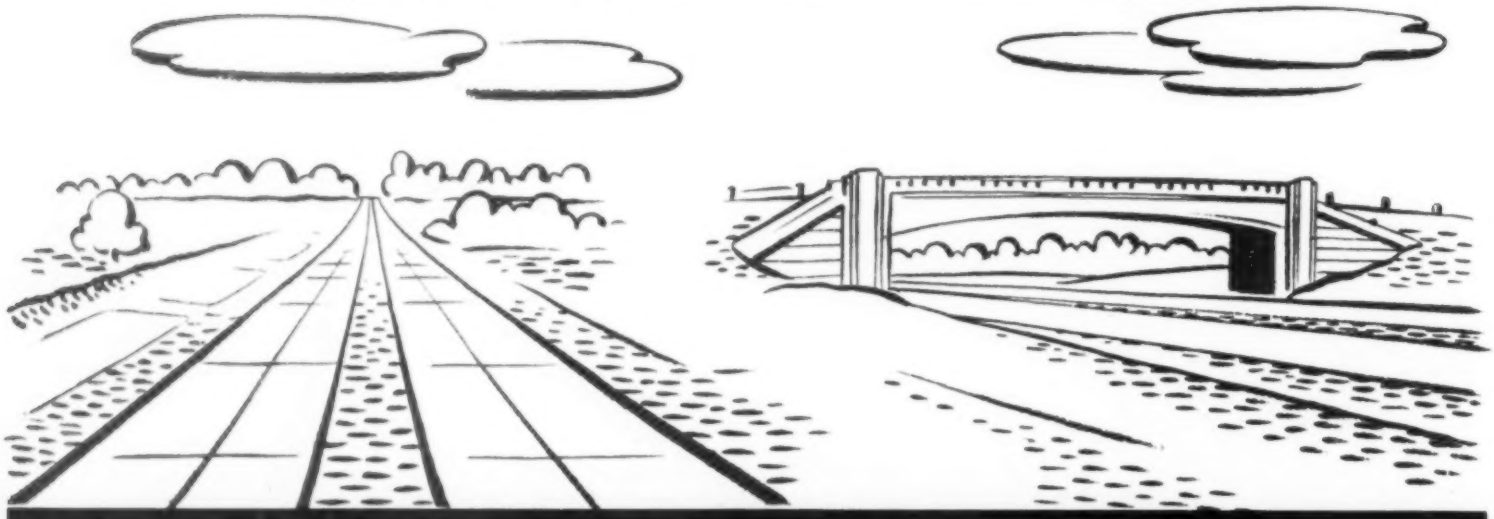
A TRIBUTE

TO PENNSYLVANIA TURNPIKE COMMISSION AND CONTRACTORS

Now, that the Pennsylvania Turnpike has reached substantial completion, we pay tribute to the contractors and engineers who produced this masterpiece of highway transport facility — the greatest single highway project in the world. These men, by diligent effort and many long hours of hard work, have accomplished what seemed almost impossible. Working under extremely abnormal pressure, to meet a very early time limit, these men intelligently engineered and skillfully constructed a highway project normally requiring three to four years.

The key to the outstanding construction success of the enterprise lies primarily in the contract system. Efficiency and effectiveness of the contract system is proven by this milestone of engineering construction — tomorrow's road today. By the contract system, by the hard-hitting effort applied by contractors' organizations and the engineers of the Turnpike Commission, an objective has been reached and a project has been produced of which they may be justly proud.

To the Pennsylvania Turnpike Commission and its engineers, to the contractors and their energized organization, to the materials suppliers, to the engineers of the Public Works Administration, to the cooperative Pennsylvania Department of Highways, and all other participating men and agencies, we extend our heartiest congratulations.



KOEHRING COMPANY

CONSTRUCTION EQUIPMENT • MILWAUKEE, WISCONSIN

Construction Methods

ROBERT K. TOMLIN, Editor

Volume 22 | JULY, 1940 | Number 7

Construction Essential
IN DEFENSE PROGRAM

ANY LARGE-SCALE PROGRAM of national defense will make heavy demands upon the construction industry for those services which it is particularly qualified to render. Modern warfare, or adequate preparedness to resist aggression, requires the development of a huge industrial organization geared for speedy mass production not only of munitions and the implements of combat but also of the vast quantities of materials and equipment needed to modernize and mechanize our national armament. This means, at the outset, a tremendous expansion of plant capacity. Construction will be called upon to rush to early completion new industrial buildings and additions or enlargements to existing structures for housing the manufacture of aircraft, tanks, ordnance, trucks, tractors and similar items of military equipment.

Highways and Airports

National defense will call for better facilities for highway transport, particularly between important industrial centers. Road-building and paving to speed the delivery of raw materials, parts and finished products for army or navy use will be an important contribution by the construction industry to the defense program. From the military point of view our highway system contains many weak links in the form of old bridges of insufficient width and strength to carry the loads of heavy traffic. Construction's job will be to replace or repair and strengthen these obsolete structures. Likewise, transport by air, instead of on the ground, will require many new

civil airports, in addition to new or enlarged military and naval air bases, together with the necessary housing for the operating and maintenance personnel. Work of this sort, involving earth-moving, grading, drainage and paving of runways, in addition to the provision of hangars and shops, all comes within the scope of construction.

But the production of military equipment and material would be ineffective without personnel trained in the duties of the present day soldier and with a knowledge of how to use the equipment of modern warfare which industry will turn out on a mass scale. In the event of a program of military training on a nationwide scale, the construction industry would shoulder the responsibility of producing, on short notice, the necessary cantonments with their thousands of buildings for housing and servicing potential armies of citizens during their period of instruction in military technique.

Still another field which will need the services of construction is that of shipbuilding. Vessels for naval duty, as well as for the transport of goods, are a vital part of our defense program. Coupled with new construction of ships is the need for improving and enlarging naval yard and dock facilities to serve the larger sized fleets which are in prospect.

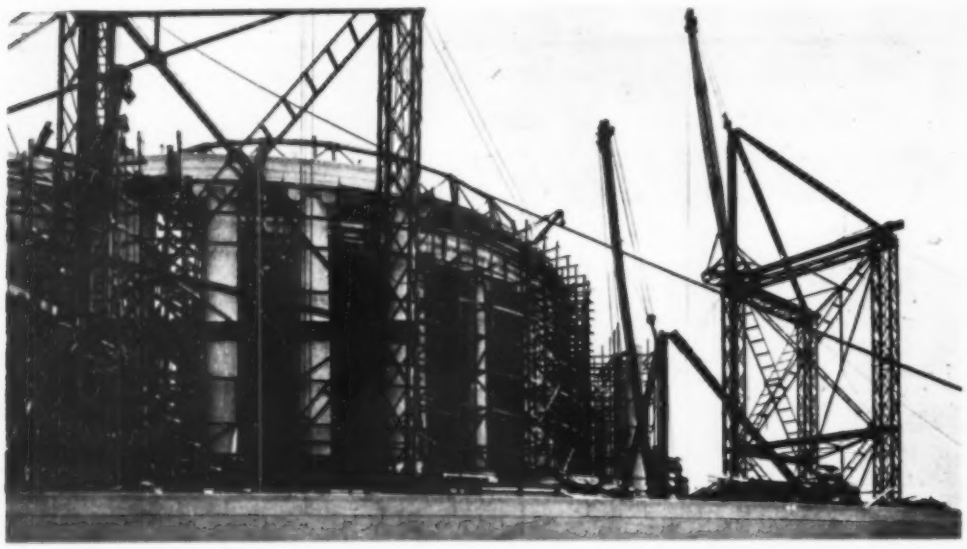
Construction, therefore, will play an essential role in providing the facilities without which a program of expanded industrial activity for adequate national defense would not be possible. The influence of the national defense program on construction activities will be reflected in the pages of *Construction Methods.*

Broad Construction Program

In this issue there is a timely article on the construction of a national airport near Washington, D. C. On another page **Assistant Secretary of War Louis Johnson**, in a statement prepared for this journal, emphasizes the military importance of arterial highways — of which the new Pennsylvania Turnpike (see p. 66) is a timely example.

We are planning other articles, as the program of construction-for-defense gains headway, on military and naval air bases, industrial buildings for manufacture of armament and mechanized equipment, highways and bridges for military needs and other structures involved in the program of preparedness. These articles will be identified by the symbol of the eagle and the words "For National Defense," reproduced on this page. — EDITOR.

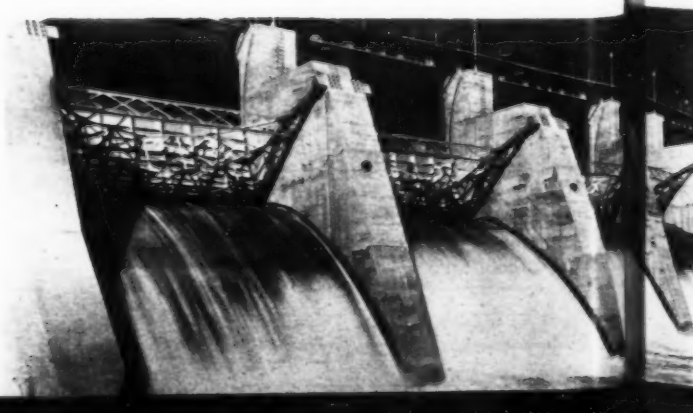
MORE THAN 60 PER CENT COMPLETED, with 1,500 of its 12,200 apartments finished for occupancy last spring, $50,000,000 Parkchester housing community of Metropolitan Life Insurance Co. in Bronx, New York, enters final stage of construction by Starrett Bros. & Eken, Inc., general contractor, leading to completion in 1941.

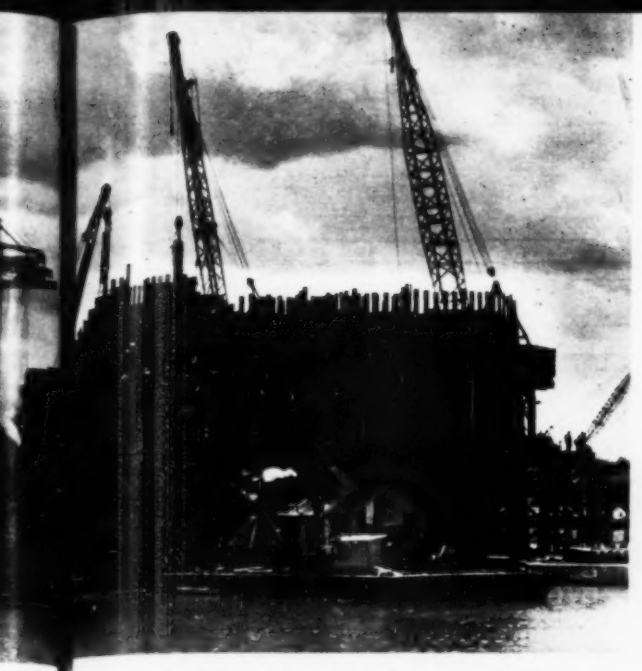


THOMAS JEFFERSON MEMORIAL takes form on shore of Tidal Basin west of Potomac Park, Washington, D.C., as John McShain Co., contractor, of Philadelphia, uses stiff-leg derricks mounted on steel towers to set marble for structure, working under $2,159,300 contract with National Park Service, F. F. Gillen, acting superintendent.

SLIP SPAN IN FLOATING BRIDGE (right) provides navigation channel through concrete pontoon structure across Lake Washington, at Seattle, Wash. Located 1,560 ft. off shore, movable draw section 378 ft. long slides back and forth in recessed waterway 220 ft. in length and is manipulated with cables and drums to provide channel 202 ft. wide for passage of ships.

CLOSURE OF CANTILEVERS (below) on $3,000,000 Jamestown bridge across Narragansett Bay, Rhode Island, was made last month by Harris Structural Steel Co., of New York City for Jamestown Bridge Commission. Structure, including approaches, is 7,000 ft. long and is supported by 70 concrete piers carrying 600-ft. main channel cantilever span, deck trusses and continuous steel girders.—Photo from THOMAS IVERSON, resident engineer inspector for PWA.

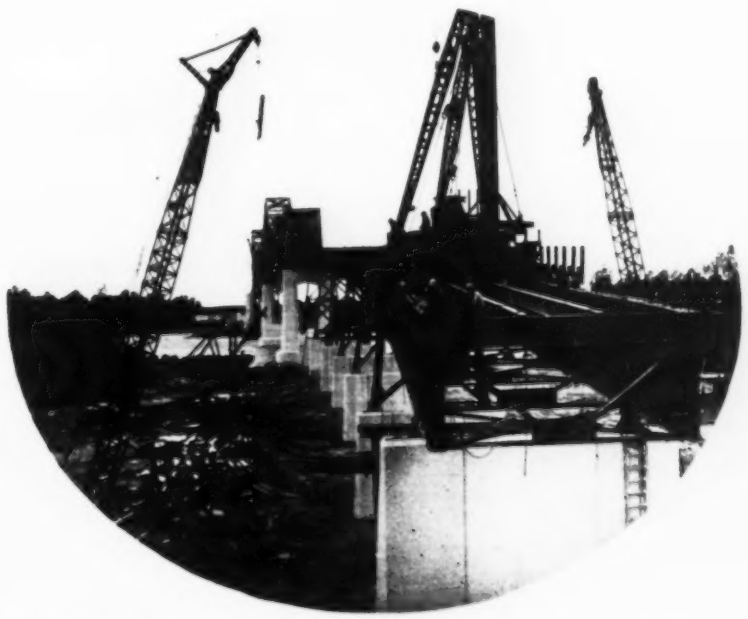




AT KENTUCKY DAM on Tennessee River near Gilbertsville, Ky., 22 mi. above its mouth at Paducah, forces of Tennessee Valley Authority erect one of largest cofferdams ever built for dam construction. It consists of circular cells 100 ft. high of interlocking steel sheetpiling driven to rock and filled with sand and gravel. Dam scheduled for completion in 1945 at cost of $95,000,000 received first bucketful of concrete (inset) on June 3 when 4-yd. bucket dumped batch into forms for navigation lock.

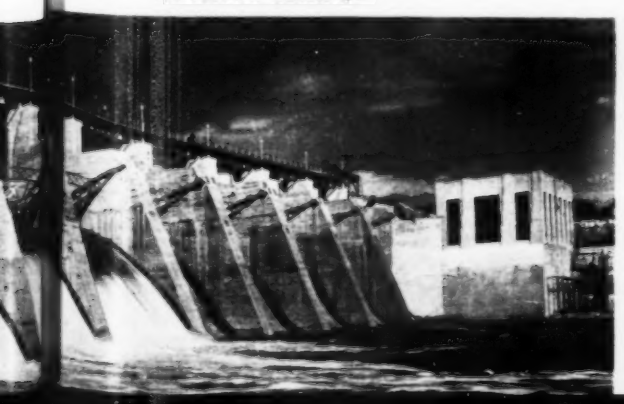
BELT PARKWAY, 31-mi. non-stop express route linking Bronx-Whitestone bridge (in background) in New York City's Borough of Queens, with Brocklyn waterfront, is ready for opening to traffic this month. Six-lane concrete-paved route required construction of seventy bridges to eliminate grade crossings, as described in "Construction Methods" for January. Project costing $28,000,000 is result of joint effort by city's Department of Parks, New York State Highway Department and Madigan-Hyland, consulting engineers.

THIS MONTH'S NEWS REEL

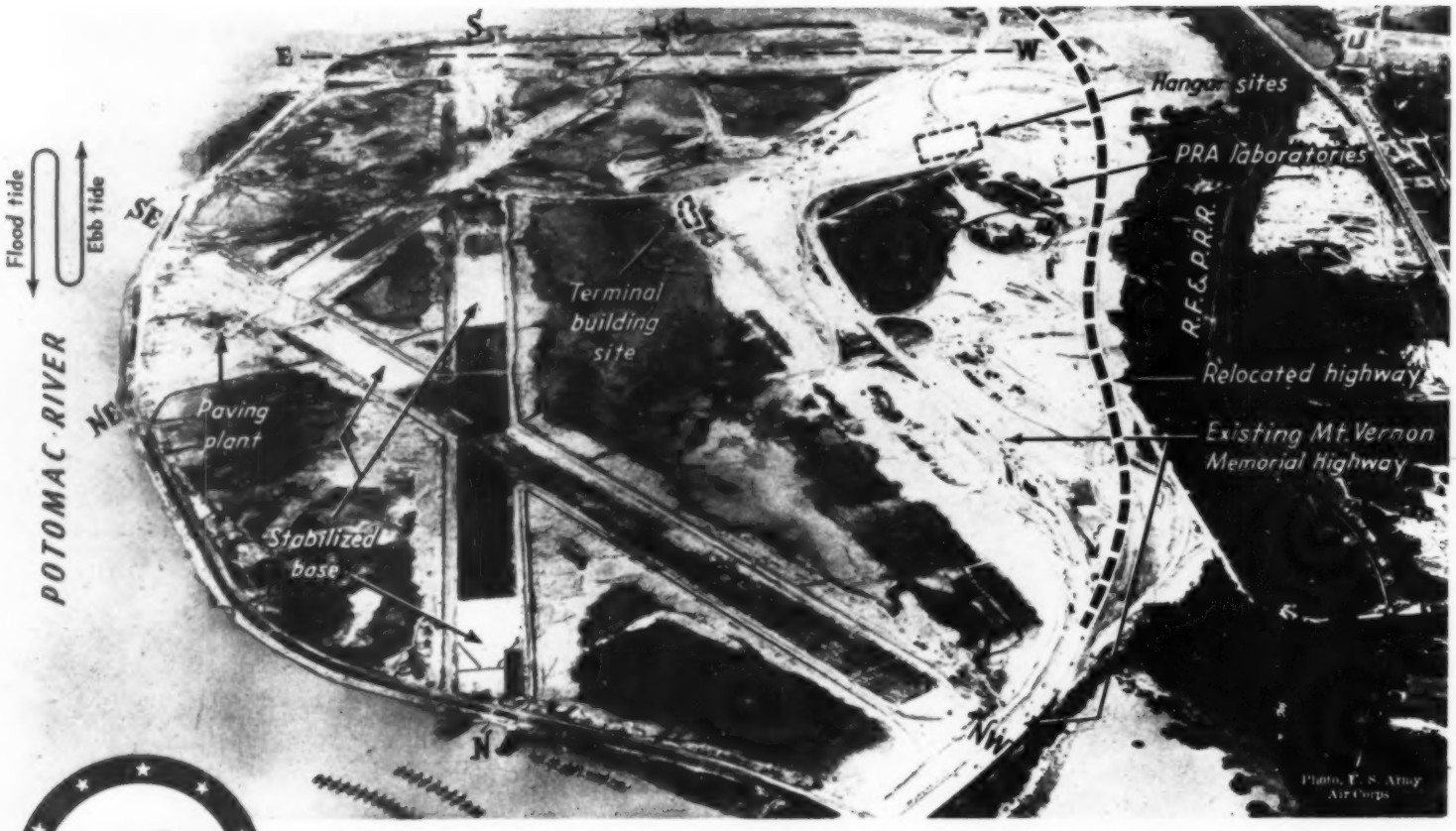


MISSISSIPPI RIVER CROSSING at Greenville, Miss., nears completion as crew of American Bridge Co. erects steel for approaches to structure of cantilever type. Bridge requiring 10,700 tons of structural steel is 9,957 ft. long between abutments and includes main cantilever span of 840 ft. and two side spans each of 640 ft. Girder span lengths range from 219 to 53½ ft. Design and supervision for $3,737,310 project are by Ash-Howard-Needles & Tammen, of Kansas City, Mo. and New York City, consulting engineers for City of Greenville.

RECONSTRUCTED AUSTIN DAM (below), with checkered career of failures since original completion in 1893, resumes service on Lower Colorado River in Texas. Photograph shows water passing over rebuilt hollow reinforced-concrete section equipped with Tainter gates. In present form dam has overall length of 1,520 ft. and was reconstructed under direction of R. B. ALSOP, superintendent of construction for Lower Colorado River Authority.



TO CARRY BELT CONVEYOR for delivery of concrete aggregates across Sacramento River at Shasta dam, U. S. Bureau of Reclamation project in California, steel truss bridge is erected on concrete piers with aid of special Bay City truck-crane equipped with 90-ft. boom and 10-ft. jib for lifts of 75 ft. Crane is fitted with heavy-duty outriggers and base frame for stability. Two of these machines are operated by Bigge Drayage Co. for Columbia Construction Co.



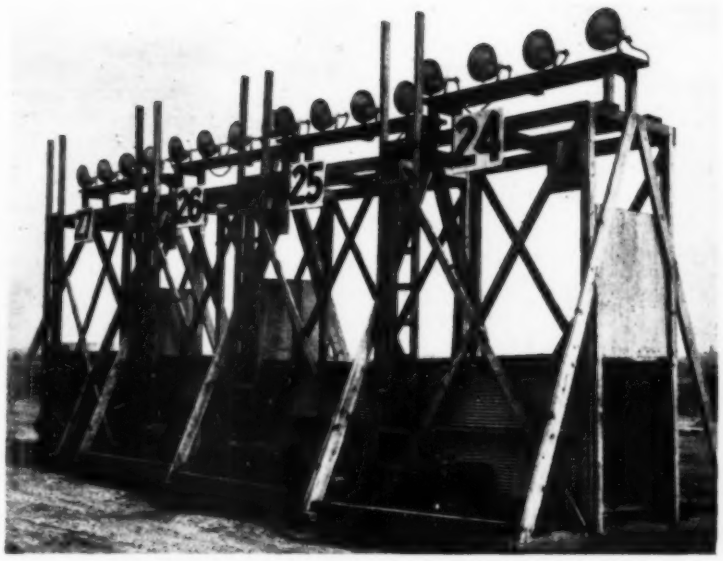
WASHINGTON NATIONAL AIRPORT at Gravelly Point on Virginia side of Potomac River shows evidences of progress in runway base stabilization by June 2, with portions of base already stabilized and primed with tar on North-South runway 6,875 ft. long and Northwest-Southeast runway 5,300 ft. long, both of which are being paved to 200-ft. width. Locations of Northeast-Southwest runway and East-West runway, each 150 ft. wide, are indicated by lettering and by partial grading and stabilization. Asphaltic concrete runway pavement, terminal building and one of six projected hangars will be completed in time to allow use of airport by November, when schedule of 130 planes per day will land and take off from the field.

Heavy Equipment Stabilizes 9-In. "Soil Concrete" Base for *Washington Airport Runways*

OVERSIZE COBBLESTONES larger than man's fist are removed by hand from surface of unstabilized material. In background, pile of binder soil is being distributed by hand shovel over measured rectangle.

HEAVY CULTIVATOR with widely spaced teeth operates first behind 70-hp. track-type tractor to start mixing of unstabilized material and to bring oversized gravel boulders to surface. Later, after soil binder has been added and plowed into material, same cultivator goes back to aid in producing uniform, homogeneous mixture of sand, gravel and binder soil, being drawn in this case (as illustrated here) by pneumatic-tired wheel tractor when soil moisture conditions permit.

EVEN HEAVIER CULTIVATOR, with closely spaced teeth, follows first cultivator on both mixing operations, being powered by 70-hp. crawler tractor when working unstabilized sand-gravel and by 40-hp. wheel tractor when feasible on later mixing. Cultivators of this type, heaviest available today, make it possible to mix soils to loose depth of 12 in. or more required for final compacted thickness of 9 in.



TO RUSH AIRPORT TO COMPLETION, total of 28 light towers is on hand for night work. Each unit, mounted on skids, carries 2,000-w. 110-v. gasoline-electric generating plant and four floodlamps.

EXTREMELY DETRIMENTAL IF NEGLECTED, pockets of mud, clay and fine sand are excavated to depths of 3 ft. or more, as required for stability, and are backfilled with sand-gravel from piles of surcharged material such as appear in background. Excavated mud has been loaded into pick-up bucket to be carried away by bucket truck.

AIRPORTS ESSENTIAL FOR NATIONAL DEFENSE

In America's program for National Defense airports of all types, both military and civil, will constitute such an important element that the timeliness of the accompanying article is apparent. The magazine "Aviation", a McGraw-Hill publication, says in its June issue:

"We cannot operate our aircraft from country roads or city streets. We must have bases and more bases and adequate housing facilities at a time when airports are too few and hangar space is at a premium."

AFTER BINDER SOIL has been distributed on surface of unstabilized material, 18-in. four-bottom gang plow drawn by 70-hp. diesel tractor turns binder into sand-gravel course in preparation for mixing by cultivators and disk harrows.

FAVORED WITH EXCELLENT RUNWAY foundations of dredged sand-gravel averaging 20 ft. thick, and guided by the engineering counsel of several collaborating government departments, constructors of the vast Washington National Airport on the Potomac River at Gravelly Point, Va., 10 min. by motor car from the downtown post office of Washington, D. C. are utilizing materials available on the site and the largest equipment at present obtainable to produce high-density 9-in. base by single-course construction at low cost. Following plans and specifications approved by an Interdepartmental Engineering Commission, for which the Civil Aeronautics Authority provides runway design, the U.S. Engineers direct WPA labor in the handwork and machine operations involved in building stabilized, compacted, clay-sand-gravel base (appropriately termed "soil concrete") having a minimum density of 130 lb. per cubic foot at an estimated cost borne out by experience to date, of 30c. per square yard.

Airport Layout — Of a total of 729 acres in the airport site, 556 acres are in the landing field. An accompanying air view indicates the locations of the four

CULTIVATOR AND DISK HARROW make repeated trips over area of about 10,000 sq.yd. to assure thorough mixing of soil binder with sand and gravel.

SPRINKLER TRUCK adds required water to stabilized mixture in preparation for initial compaction by pneumatic-tired rollers, while 28-in. tandem disks complete mixing operation.

ON THE JOB at Washington National Airport: (left to right) H. H. HOUK, Civil Aeronautics Authority, resident engineer; Capt. W. N. LEAF, Corps of Engineers, U. S. Army, officer in charge of construction; and GAYLE McFADDEN, senior engineer, U. S. Engineers, chief of operations.

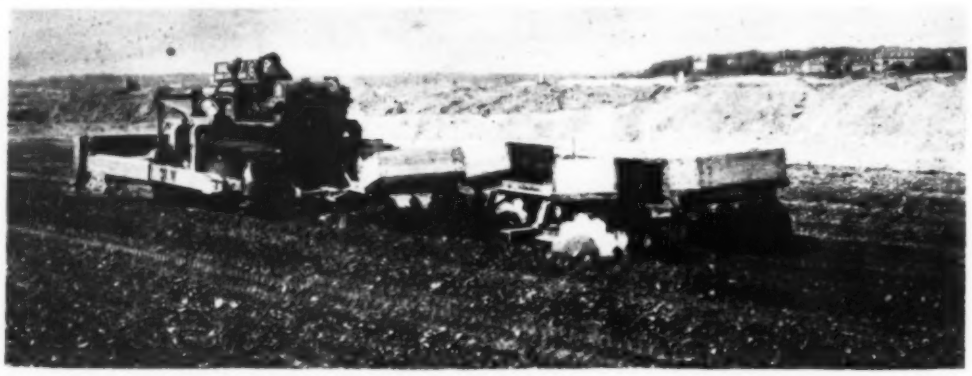
GREAT DENSITY and close texture resembling lean cement concrete are exhibited by compacted, stabilized mixture, unprimed in lower part of picture and primed with tar in upper part.

runways, 4,100 to 6,875 ft. in length, and shows the extent of base construction already accomplished on two 200-ft. runways when the photograph was made on June 2. At that time, about $5,000,000 already had been expended out of a total appropriation of $9,886,000 for the Washington National Airport.

For the four runways, for aprons and for taxiways totaling 11,000 lin. ft. the project requires 677,000 sq.yd. of 9-in. stabilized base. Briefly described, the base is stabilized mechanically by (1) working the sand-gravel with heavy cultivators, (2) taking out oversize gravel boulders, (3) spreading the required amount of binder soil, (4) plowing and disking to produce a homogeneous mixture, and (5) compacting with pneumatic-tired and smooth rollers, water being added as required. The base is primed with tar in preparation for paving with a 2-in. asphaltic concrete binder course, followed by a 1½-in. asphaltic concrete surface course.

Construction Schedule — By the middle of May the paving contractor had erected an asphalt mixing plant and was ready to start the 677,000 sq.yd. of paving on runways, taxiways and aprons, all of which, as stipulated by the paving contract, must be completed by September. According to the plan outlined by Capt. W. N. Leaf, Corps of Engineers, U. S. Army, the base construction force intends to keep 50,000 to 75,000 sq.yd. ahead of the paving contractor, completing an average of 20,000 sq.yd. of 9-in. base per week. To maintain this schedule, the force on base construction consists of a total of five foremen, nine subforemen and 130 laborers, these men being distributed in two shifts which work a total of 80 hr. per week, two 7-hr. shifts from Monday to Friday and

(Continued on page 104)



TWO-WAY TANDEM DISKS of 28-in. diameter, weighted for full penetration into soil, mix 12-in. loose layer of gravel, sand and binder.

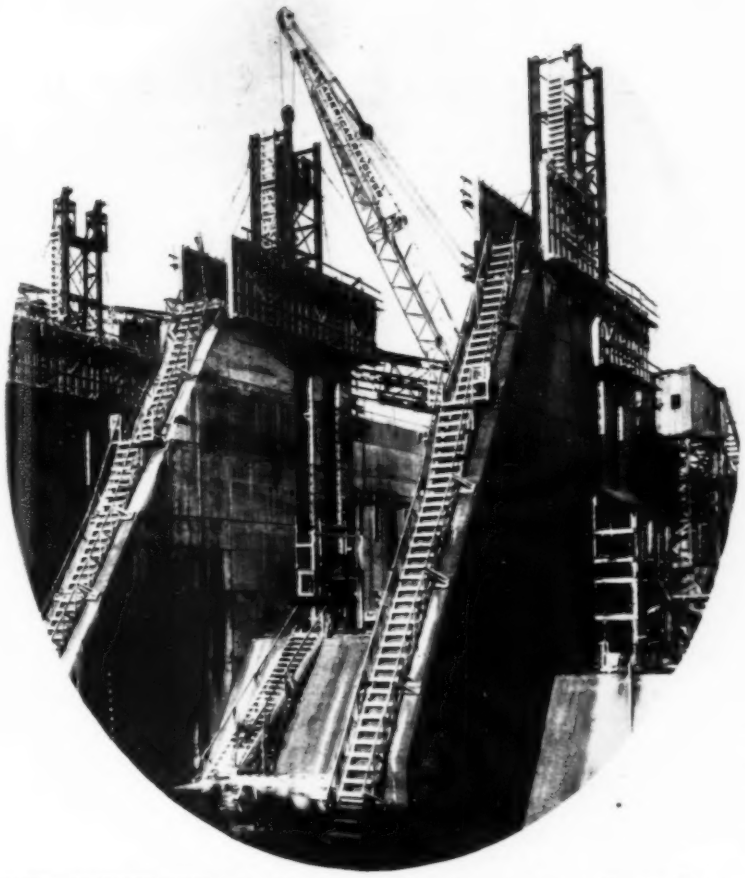
TANDEM PNEUMATIC-TIRED ROLLERS with tires inflated to about 45-lb. pressure roll properly moistened stabilized mixture to produce initial compaction.

ARRAY OF EQUIPMENT works on top of 9-in. stabilized base course as sprinkler truck adds water to create soil mortar grout for proper surface rolling under 10-ton smooth roller, while pneumatic-tired roller continues compaction of moistened base, as indicated by tire tracks in left foreground. In right background may be seen both bucket truck used for hauling binder soil and blade patrol which strikes off unstabilized and stabilized materials.

Wood Panel Forms
FOR BUILDING CONCRETE DAMS
Part II

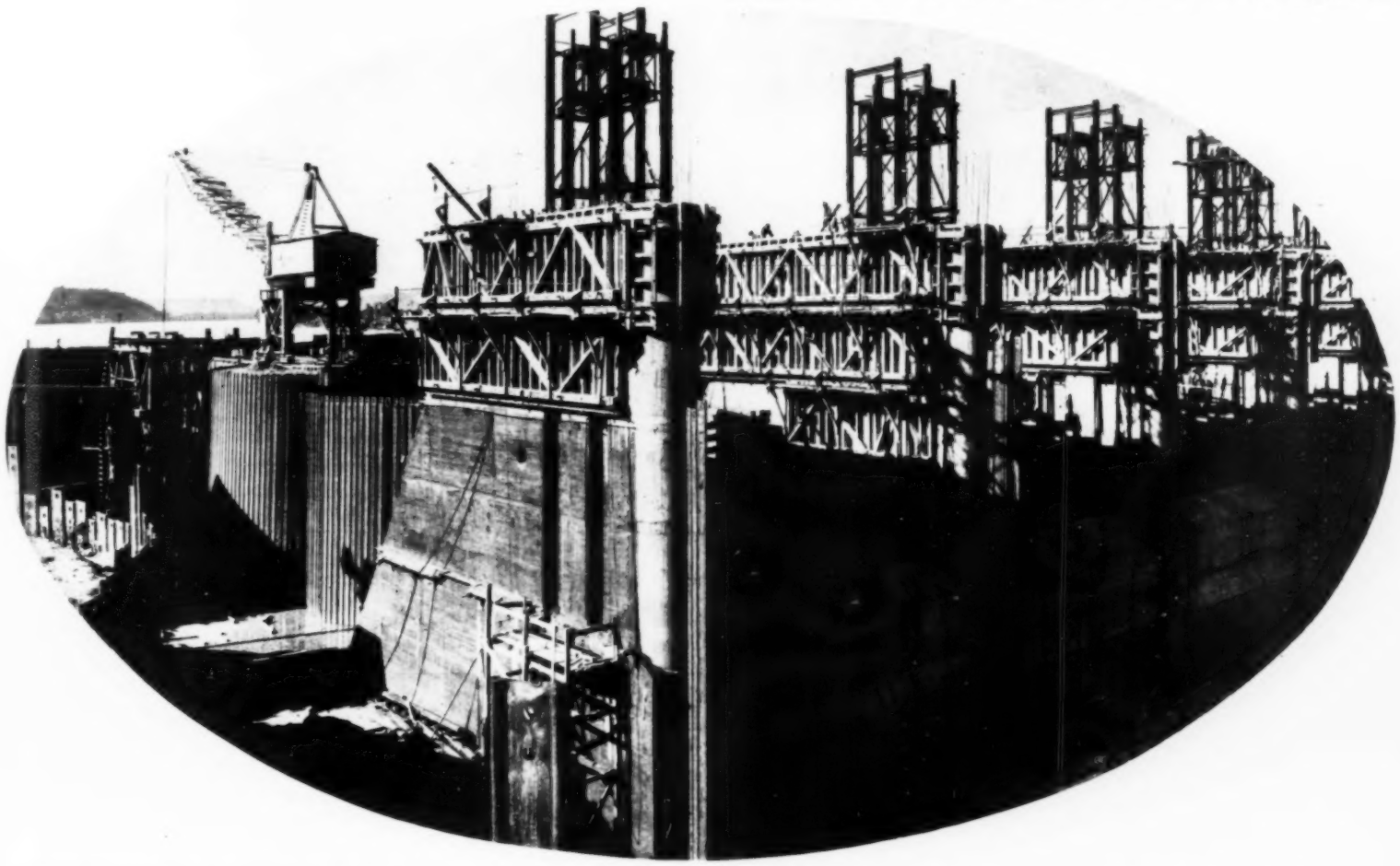
Second of a Series of Articles Dealing with Form Design, Manufacture, Handling and Cost-Keeping Methods

By H. P. MAXTON
General Cost Engineer,
Tennessee Valley Authority
Knoxville, Tenn.



SINGLE-COURSE PANEL for 10-ft. lift is raised by crane on spillway pier of Chickamauga Dam. A-frames, one of which may be seen against opposite form on pier, ordinarily lift panels at Chickamauga.

EFFORTS HAVE BEEN MADE to use steel panels for large dams, but in most cases it has been concluded that wood panels would be more satisfactory. This conclusion is determined largely by the many special structural or architectural features that must be incorporated in the face of a dam. In addition, it is necessary to support reinforcing steel and a large variety of piping and inserts which require the cutting or penetration of panels for pipe, electric conduits and similar elements. Furthermore, the weight of steel panels places a limitation on their size and usually requires a larger number to be handled than is necessary when lighter timber panels are used. As a rule, steel reusable forms are best adapted to



GUNTERSVILLE DAM SPILLWAY PIERS are concreted in 10-ft. lifts, concrete being placed inside upper belt of double-row panels. Note forms for rounded pier noses held in place by semi-circular outside girth rods, without internal ties.

TYPICAL DESIGNS OF WOOD PANEL FORMS FOR TVA

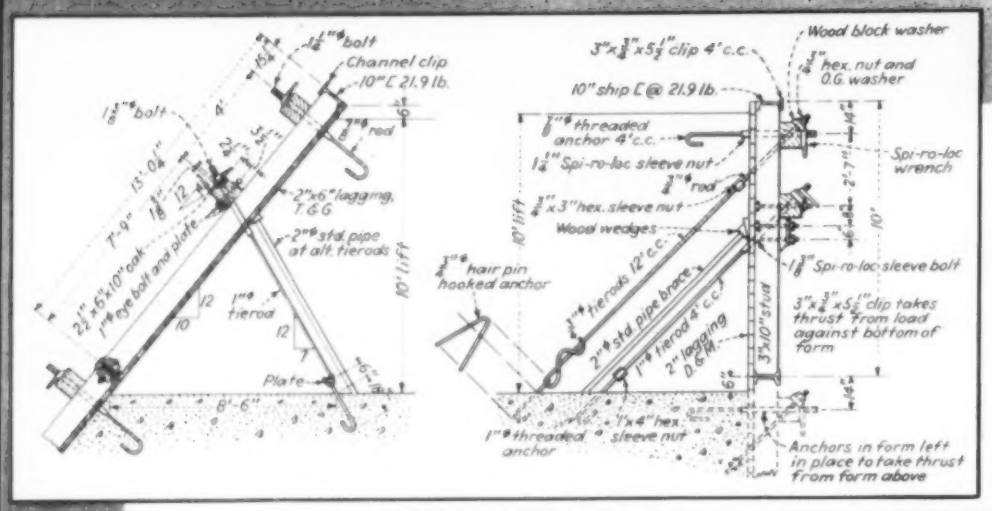
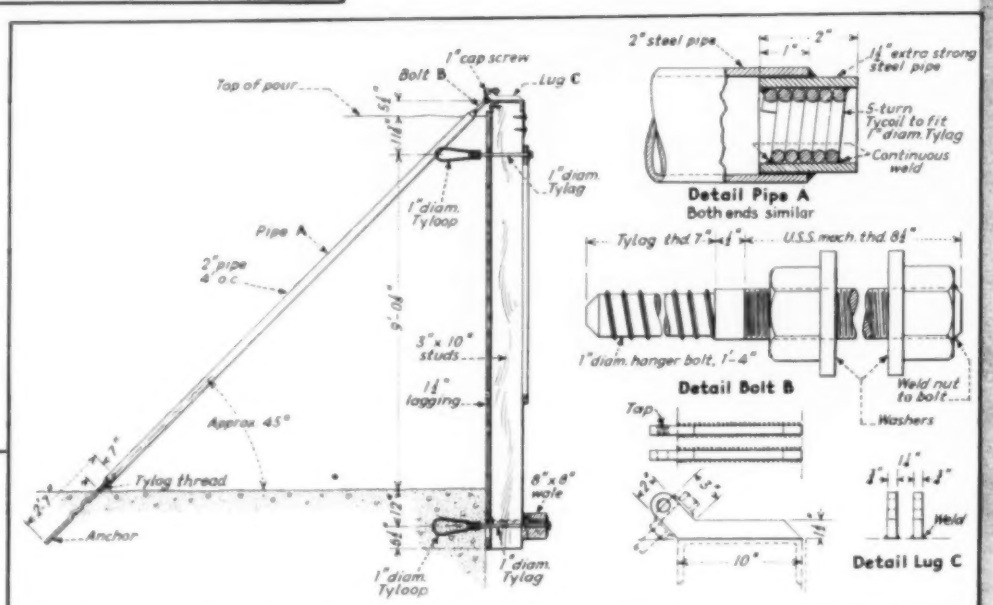
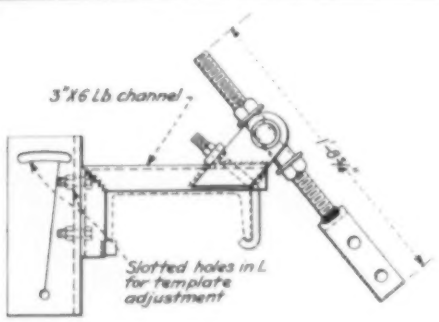


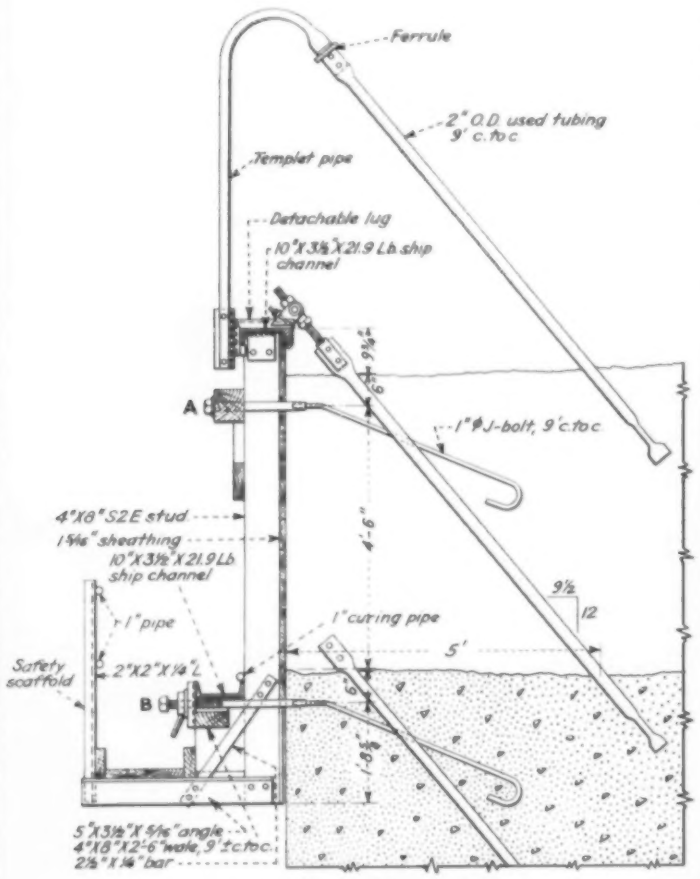
Fig. 1 . . . **TYPICAL DOUBLE-ROW PANEL DESIGN** is employed in forming 10-ft. concrete lifts of lock walls at Pickwick Landing, third in list of eight dam projects so far undertaken by TVA.

Fig. 2 . . . **TYPICAL SINGLE-ROW PANELS (right)** form 10-ft. concrete lifts in Chickamauga dam and lock, fifth in series of river control projects completed or put under construction by TVA to date.





Detachable Lug

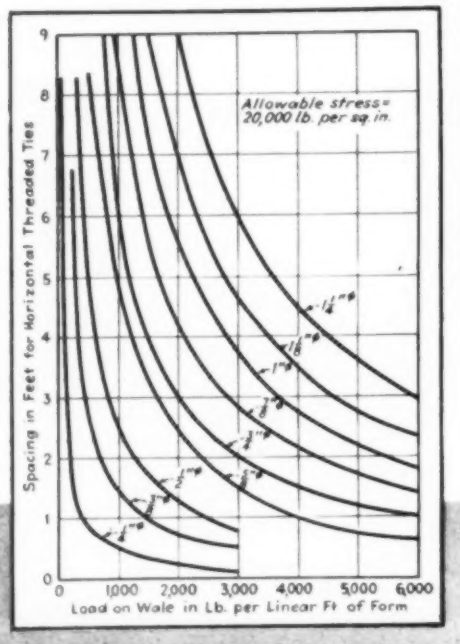


Section through Standard Panel

Sleeve bolts A and B and 4"X8"X2'-6" wale are removed before raising form. Sleeve bolt B replaces A as each lift is made.

Fig. 3 . . . **PIPE TEMPLETS (left)** to locate inclined tie-braces accurately in successive 5-ft. lifts of concrete are feature of single-course form design for TVA's sixth big job, Hiwassee Dam, recently completed. Safety scaffold aids erection and stripping.

Fig. 4 . . . **SPACING OF HORIZONTAL THREADED TIES (below),** based on allowable rod stress of 20,000 lb. per square inch on net area at root of thread, is indicated by curves correlating minimum rod diameters with concrete pressures on forms.



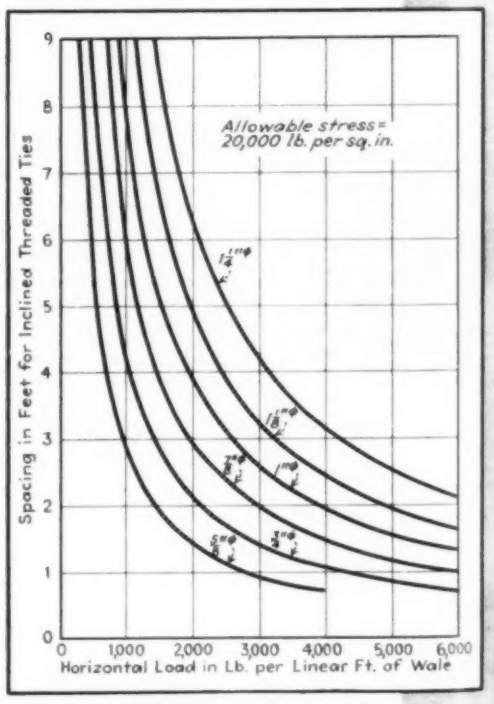


Fig. 5 . . . **SPACING OF 45-DEG. INCLINED THREADED TIES,** based on allowable rod stress of 20,000 lb. per square inch on net area at root of thread, is shown by curves for various minimum rod diameters and concrete pressures.

continuously recurring types of structures such as tunnel linings, culverts, walls of great length or arch centering where there is a large number of duplicate arches.

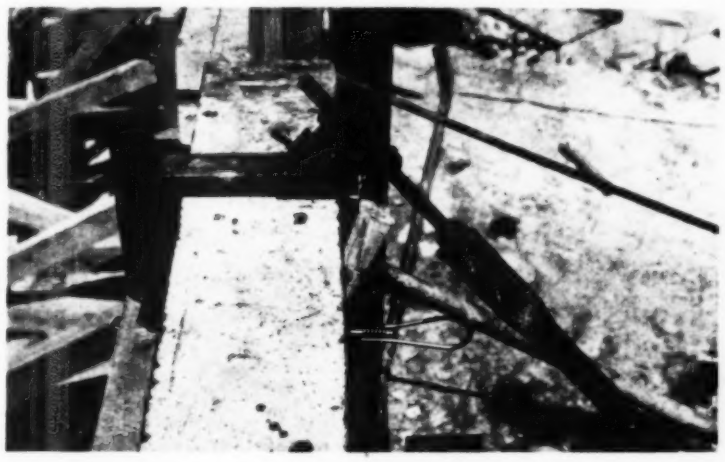
Cantilever Forms—Attempts to work up a practical cantilever form generally have been abandoned for one of several reasons: (a) weight of panels, (b) difficulties of stripping when using two lifts of panels, (c) lining up form, (d) greater deflection in cantilever form. However, it does not appear that the possibilities for a practical cantilever form are entirely exhausted, and an acceptable design may be developed.

Double vs. Single Panels — Double type panels were employed on the Norris, Wheeler, Pickwick and Guntersville projects. This type obtains its name from the fact that the lower form, previously filled with concrete, supports the upper form while the upper form is being filled with concrete. Pickwick Landing forms, Fig. 1, are double panels.

Use of double type or "step-up" panels is perhaps justified where enough time is gained, by stripping the lower row as soon as the upper form is filled, to increase the rate of production of the concrete plant. When considering this problem it is possible that the rate of

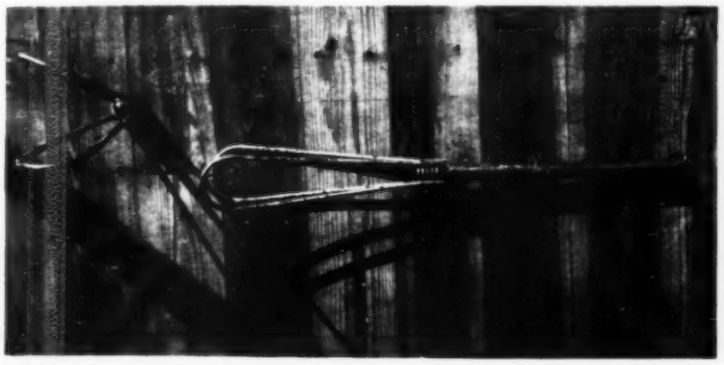
(Continued on page 87)

CONCRETING IS IN PROGRESS TODAY in navigation lock of TVA's seventh great project at Watts Bar on Tennessee River, about 75 miles above Chickamauga Dam. Prefabricated single-course wood panels are in use for vertical faces, slopes and steps.

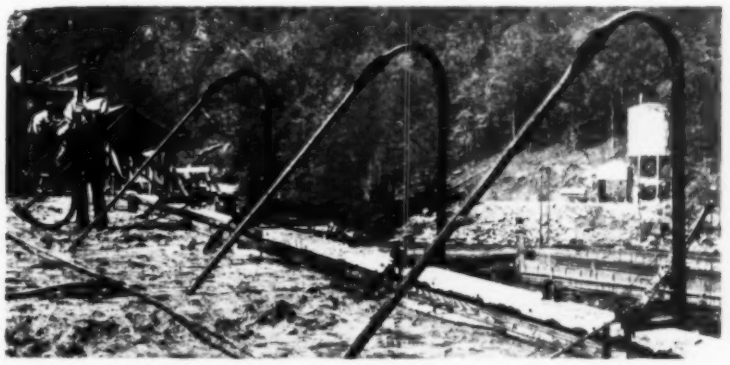


TOP DETAIL of Hiwassee Dam form shows movable lug on steel channel top wale, with attached tubular socket for pipe templet on outside of form, at left, and with lag bolt assembly connected to tie-brace, at right. Below may be seen Tyloop and, also, wedged pipe brace used in aligning form. Pipe templets on this job ordinarily are bolted to angle brackets, as shown in Fig. 3.

CRIMPED ANCHOR BOLTS for pipe struts win preference at Chickamauga by virtue of tested holding power and ease of placement in concrete.

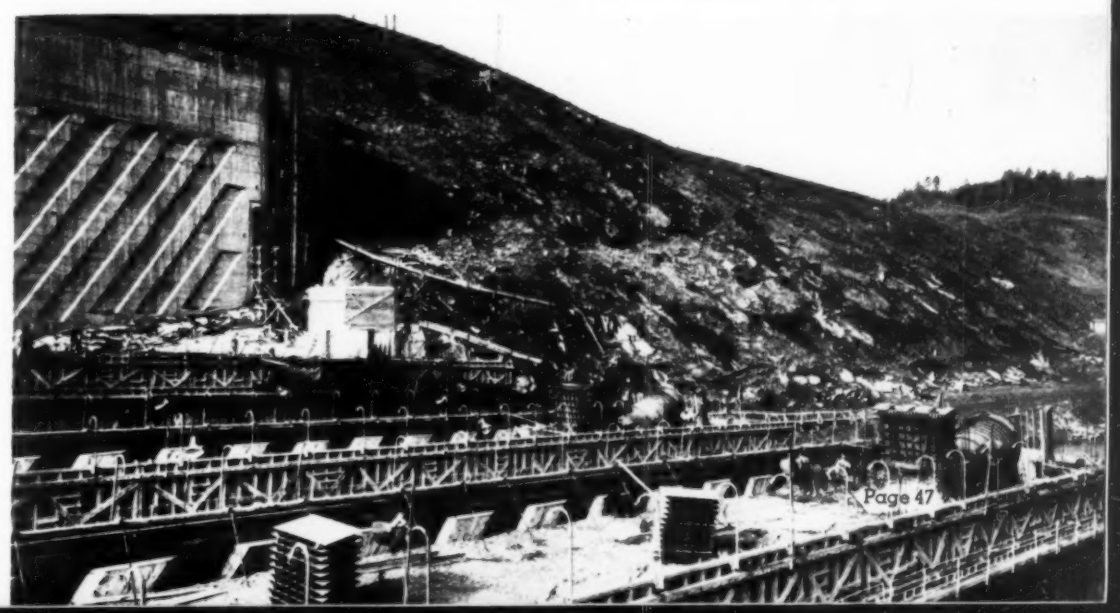


STUD BOLT ASSEMBLY installed near top of Chickamauga panel (Fig. 2) consists of 1-in. diameter bolt with 3-in. Tylag thread (3½ threads per inch) on which is placed Tyloop made up of coil with loops 10 in. long of 0.34-in. steel welded to it.



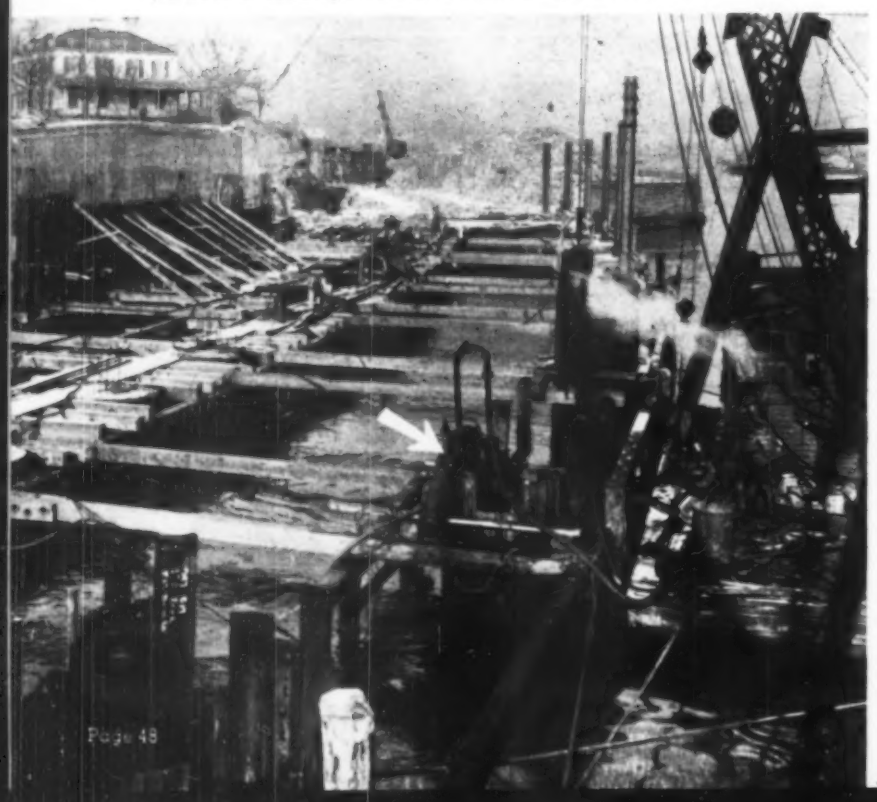
INCLINED PIPE STRUTS for next 5-ft. lift of concrete are located accurately in poured concrete by curved gooseneck tubular templets on Hiwassee Dam panels.

HIWASSEE DAM PANELS (below) are re-used forty times in concreting massive structure 307½ ft. high and 1,265 ft. long on crest. Note wood keys in place on panels to form diagonal slots as revealed in concrete of abutment block in background. Metal keys are stacked on surface of concrete.



TO FIT DIVIDED ROADWAYS of East River Drive into narrow right-of-way between existing buildings and U. S. bulkhead line south of Queensboro Bridge at 59th St., Manhattan Department of Borough Works designs double-deck viaduct, involving difficult foundation construction. In background, massive retaining walls support earth bank close to buildings. Rock bank was line-drilled and blasted to make way for viaduct.

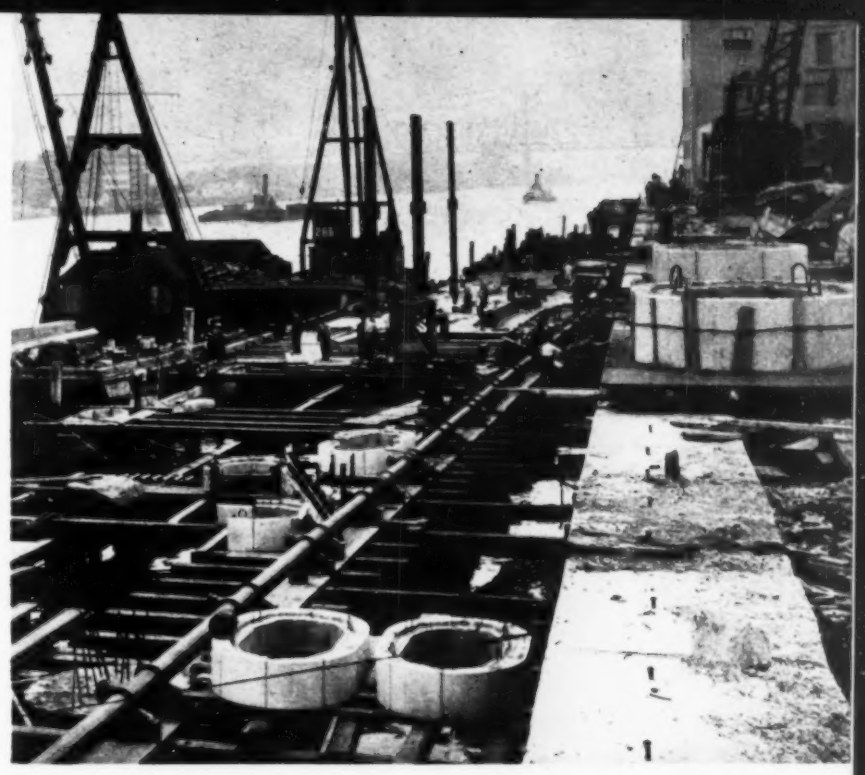
THREE LINES OF STEEL-SHEETED CONCRETE PIERS (below) carry transition section of mutiple-deck viaduct across open water to tunnel being excavated and decked over in open cut in background at Carl Schurz Park. Hanging steam-hammer operated by derrick-boat drives steel sheet-piling for one pier into bedrock. At top of another steel-sheeted caisson may be seen discharge hose (see arrow) and air supply pipe for air-lift jet used in cleaning muck out of bottom of pier shell.



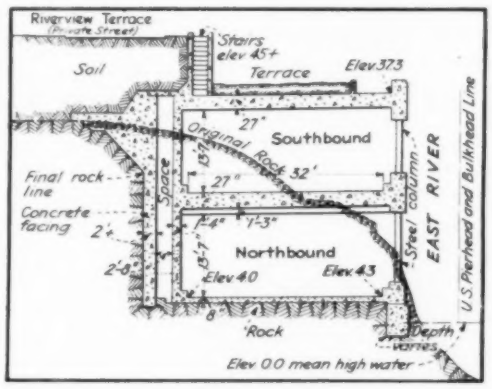
RIVERFRONT HIGHWAY *Squeezes Through Tight Places* ON DOUBLE-DECK VIADUCTS

TO PASS THE EAST RIVER DRIVE, New York City, through two extremely narrow locations where close proximity of the bulkhead line to existing buildings prohibited use of the normal divided highway section, the Manhattan Department of Borough Works designed double-deck viaducts which J. Rich Steers, Inc., and the Poirier & McLane Corp., contractors on separated sections, completed on schedule in the face of difficult and variable foundation conditions. On a contract section between 79th and 90th Sts., the Steers organization made rapid progress in constructing 96 deep water piers incased in steel sheetpiling to rock at maximum depth of 62 ft. Farther south, on a section from 54th to 64th Sts., Poirier & McLane excavated footings to rock at variable depths up to and exceeding 30 ft. below water level and faced high rock banks with concrete veneer after performing delicate line drilling and blasting of the badly seamed rock formation close to the foundations of occupied buildings.

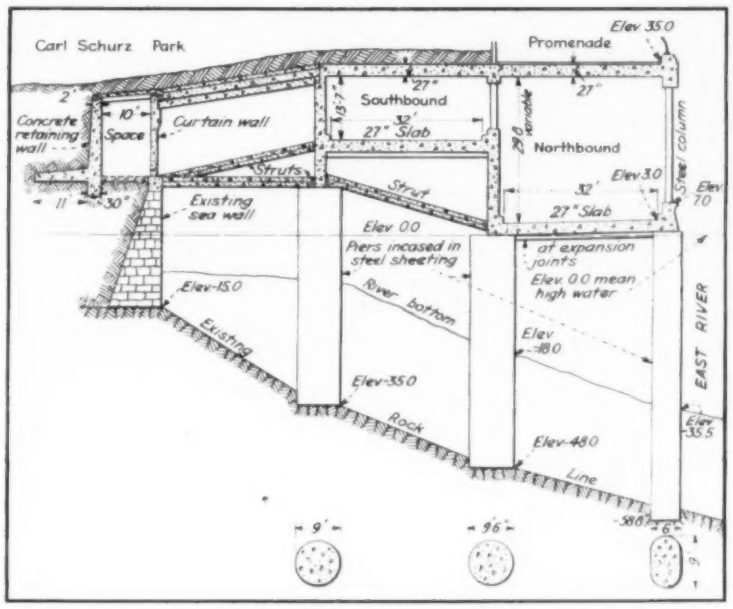
East River Drive—Both contracts are included in an $8,500,000 construction project by which Manhattan is building a 2⅓-mi. section of its east side circumferential freeway



GRANITE FACING for outer line of piers is precast in rings, one course high, backed up by 6 in. of concrete, with U-rods embedded in concrete to facilitate placement of rings on piers.

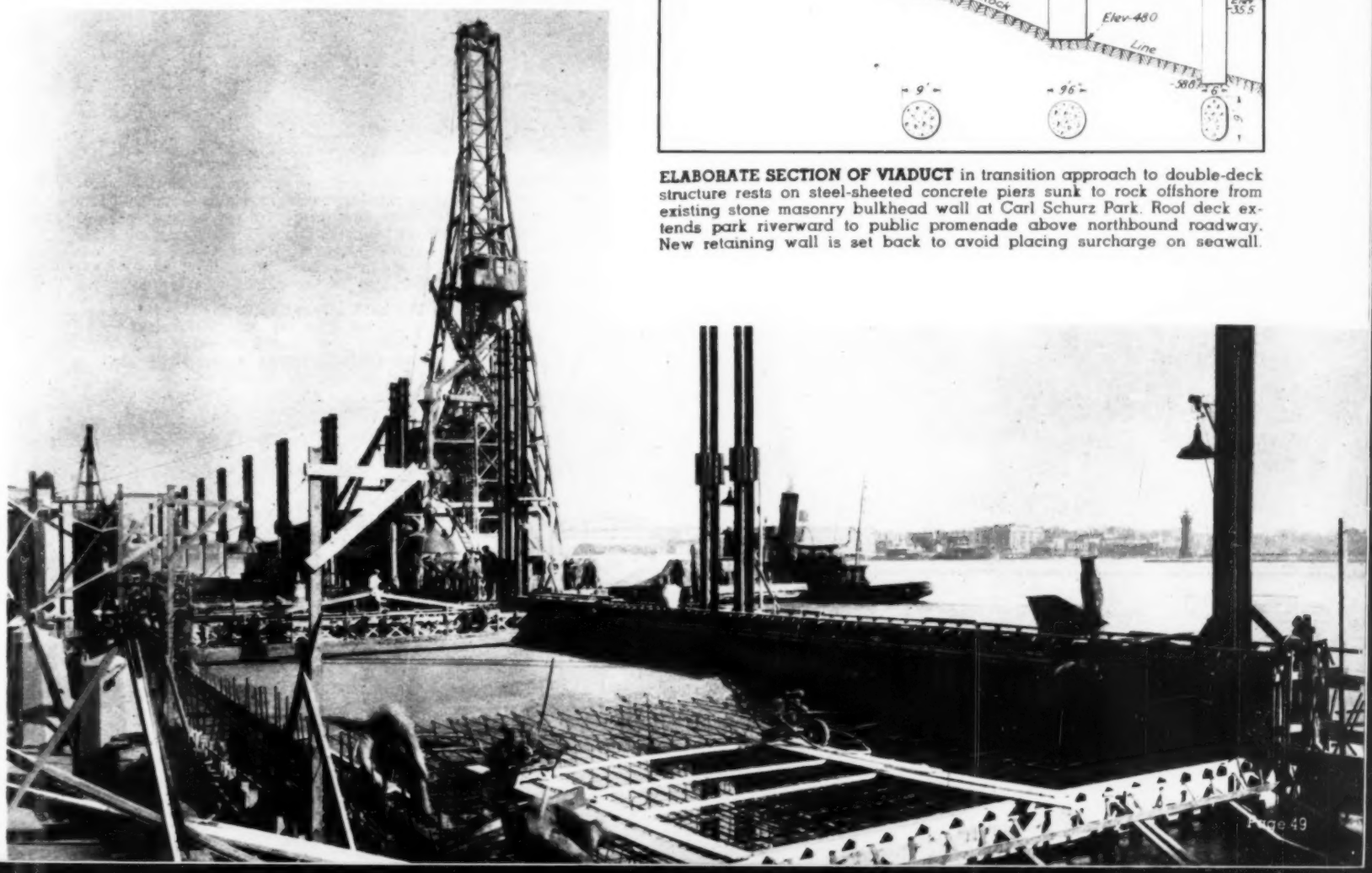


DOUBLE DECK VIADUCT (left) covered by roof slab accommodates two roadways of East River Drive on narrow shorefront location obtained by easement through private property between 58th and 59th Sts. In this instance, private property owners retain use of roof and pay additional cost of constructing third deck.



ELABORATE SECTION OF VIADUCT in transition approach to double-deck structure rests on steel-sheeted concrete piers sunk to rock offshore from existing stone masonry bulkhead wall at Carl Schurz Park. Roof deck extends park riverward to public promenade above northbound roadway. New retaining wall is set back to avoid placing surcharge on seawall.

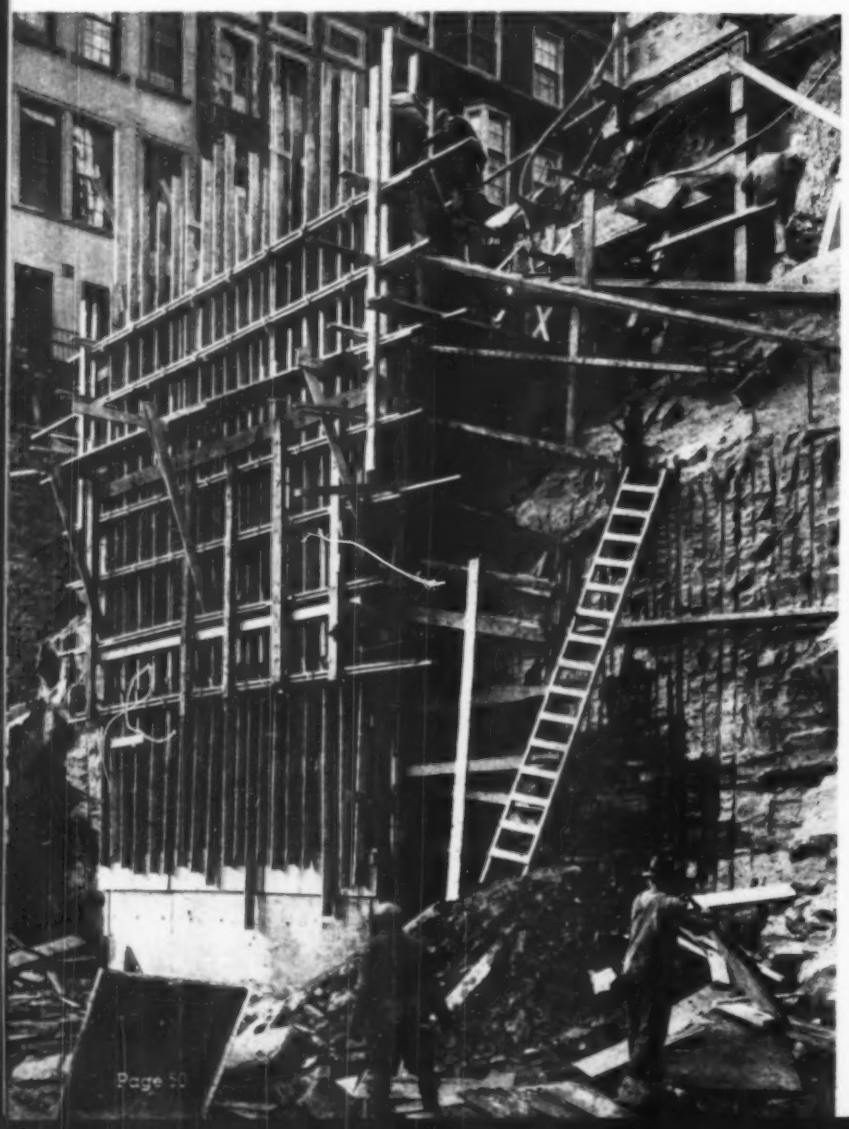
AT HIGH TIDE (below). East River comes up over slab forms for lower deck of viaduct. Falsework previously used for pier construction supports these forms. Floating concrete plant equipped with tall hoist tower delivers concrete by chutes to deck, where it is spread by hand and finished by self-propelled pavement finishing machine. Portable gasoline-powered vibrators aid flow and consolidation of concrete around heavy reinforcement.



STEEL GIRDERS replace normal reinforced-concrete construction in transition section where upper tier of steel columns, to support roof slab, is offset inside lower tier of columns.

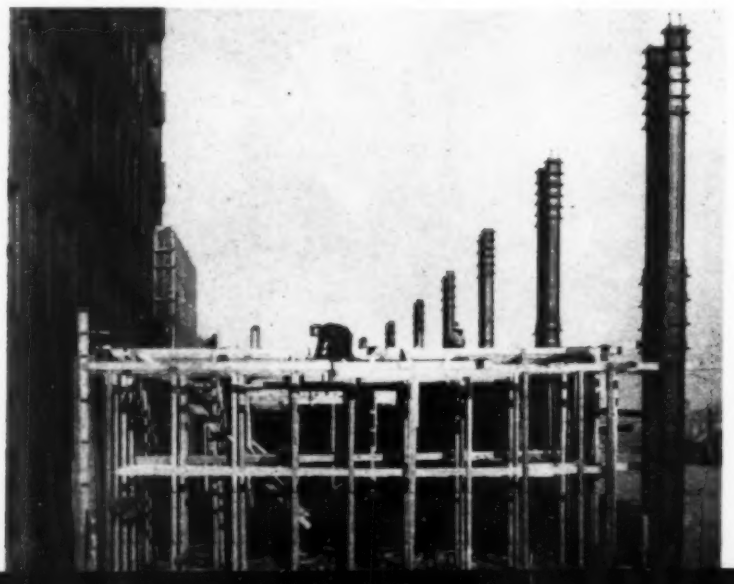
L. VAN HOUTEN, superintendent for J. Rich Steers, Inc., contractor, directs construction of contract section from 79th to 90th Sts.

ROCK BANK (below) at foot of East 58th St., where Manhattan schist is fractured by seams dipping toward river, is line-drilled and blasted to vertical face which is covered by concrete veneer and capped by retaining wall to hold earth overburden before contractor starts line-drilling of next section of rock bluff. Note steel pins in top of bank to hold rock against disturbance during drilling and blasting operations.



EVEN BEFORE RUBBING, walls and ceilings formed with plywood on upper roadway level show good surface texture and finish. Steel posts in upper tier of transition structure at this location are more closely spaced than main columns in lower tier.

ON COMPLETED LOWER DECK of viaduct **(below),** constructed close to tall building between 82nd and 83rd St., carpenters erect falsework for upper roadway slab. Roof deck is to be placed over structure at this location to carry public promenade.



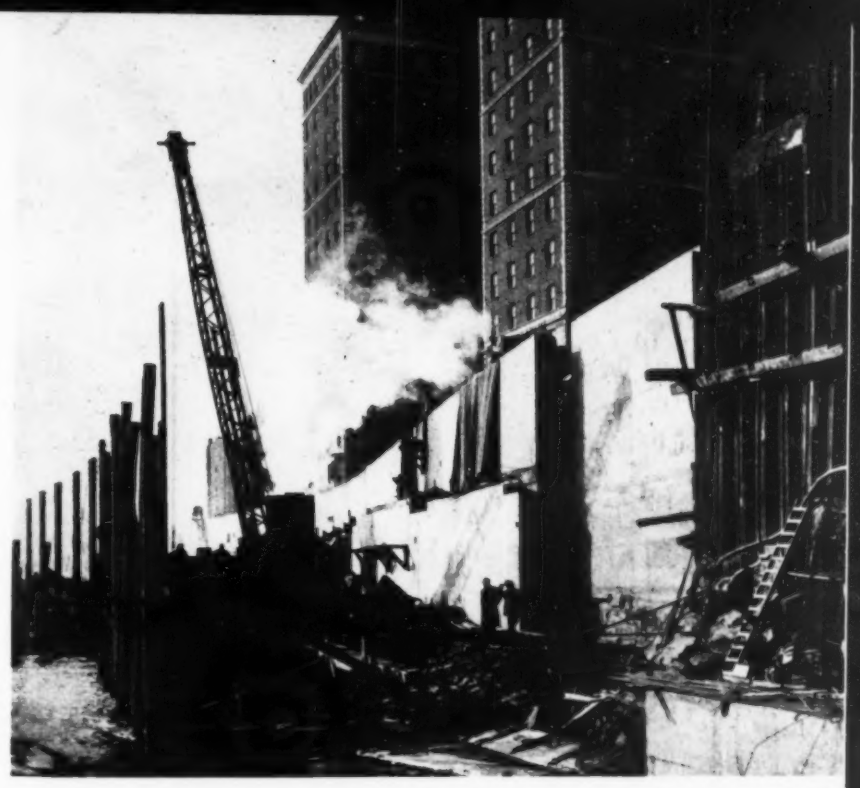
from 49th to 93rd St., where the new construction connects with an existing divided highway leading to the Triborough Bridge at 125th St. As stipulated by a grant from PWA, which furnishes 45 per cent of the construction cost, the work had to be substantially completed by June 29, and official opening of the highway was set for June 18. With completion of this section and of two short links under construction farther south, only one gap from 30th to 49th Sts. remains to be built in a continuous riverside thoroughfare more than 7 mi. in length from Montgomery St. to 125th St. Plans are now in process for the 30th-49th St. link, which will be constructed in 1941.

Normal cross-section of the trafficway comprises two three-lane roadways with a separating island between them. A public promenade borders the roadway on the river side and at several points connects by means of pedestrian bridges with a parallel sidewalk on the opposite side.

Double-Deck Viaducts — Two sketches reproduced with these notes show cross-sections of double-deck viaducts in which three-lane roadways are carried at separated levels and a roof slab is placed over the structure to support landscaped lawns or a public promenade. A roof deck is used over portions of the viaducts on both contracts; the additional cost of constructing the third deck is borne by private property owners where they derive the benefits of the roof, as between 56th and 59th Sts. Where the roof deck is constructed for public use, as between 81st and 90th Sts., in and near Carl Schurz Park, the Borough of Manhattan pays the cost.

Roadways and roofs of the mutliple-deck viaduct consist of heavily reinforced concrete slabs 27 in. thick supported on

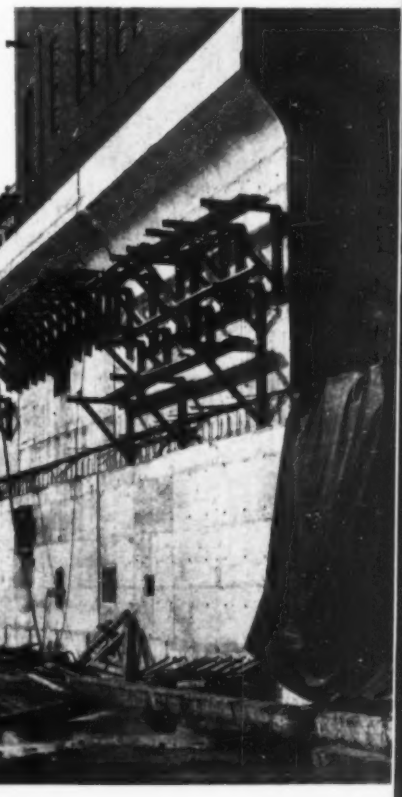
(Continued on page 96)



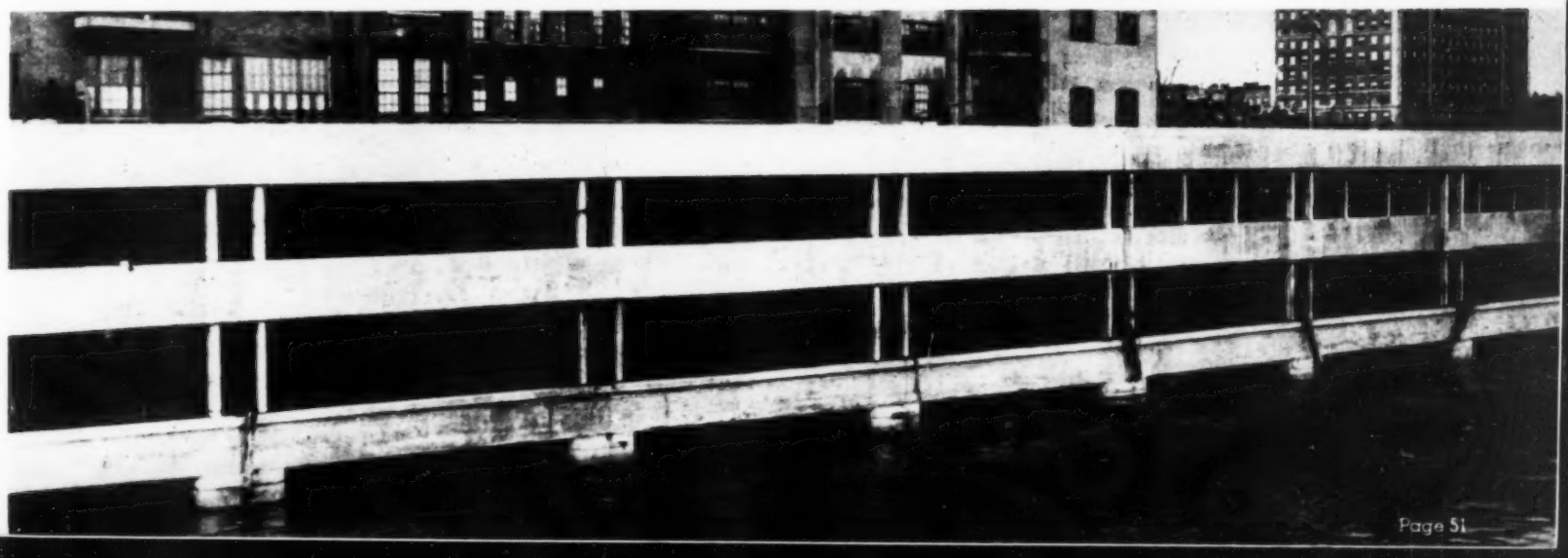
MASSIVE CONCRETE FOOTINGS for walls and viaduct structure south of 58th St. are excavated to rock at variable depths ranging up to 30 ft. below water level. Cofferdam at left incloses excavation for concrete gravity bulkhead wall.

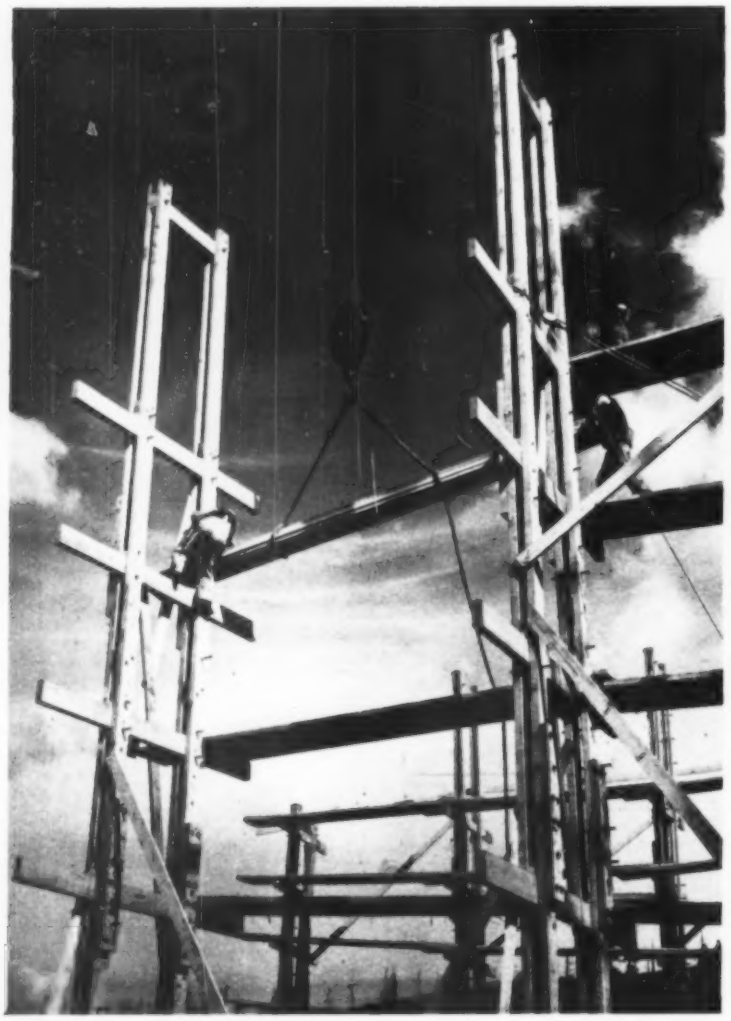
INSPECTION TRIP over East River Drive brings together number of men responsible for conceiving and executing project: (left to right) NEWBOLD MORRIS, president of city council; STANLEY M. ISAACS, borough president, Manhattan; L. C. HAMMOND, chief engineer, Manhattan Department of Borough Works; P. RIZACK, division engineer in charge of construction; WALTER D. BINGER, commissioner of borough works; and JOSEPH D. McGOLDRICK, city comptroller.

CONCRETE VENEER, surmounted by gravity retaining wall with cantilever overhang to carry narrow private street in front of residences and six-story building, presents sheer face almost 40 ft. high running south from 59th St. At left are steel pipe piles driven to bedrock to provide pier foundation for viaduct.

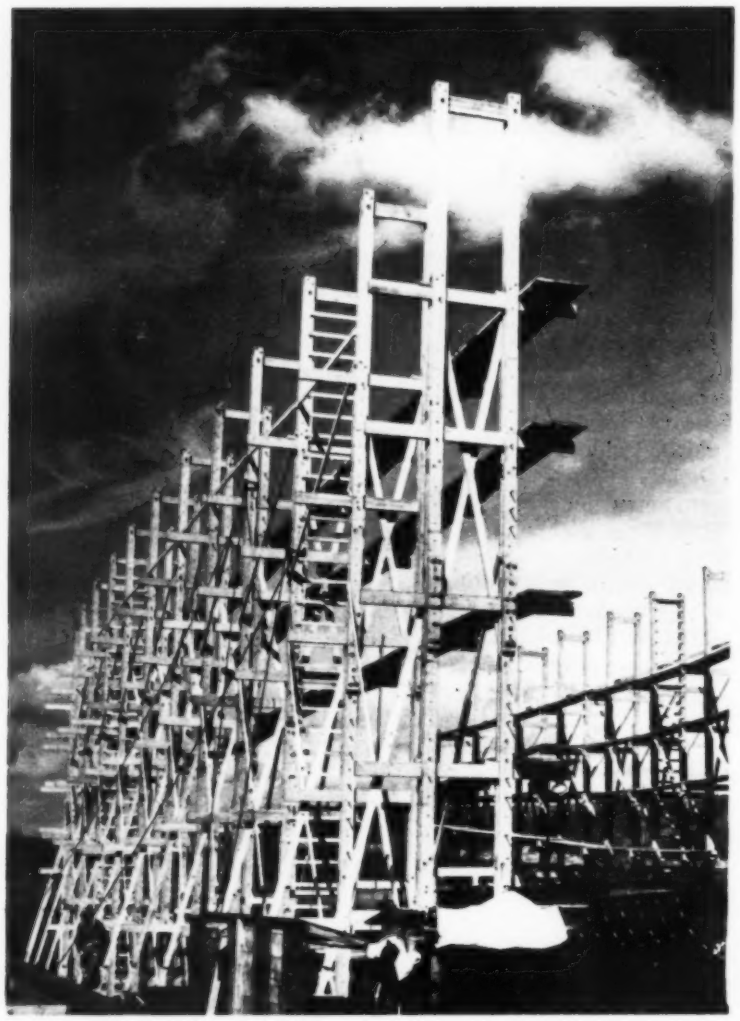


TRIPLE-DECK HIGHWAY STRUCTURE (below) extends northward toward Carl Schurz Park on three lines of steel-sheeted foundation piers.





PREFABRICATED WOOD MEMBERS bring economy and adjustability to scaffolding in new Seattle-Tacoma shipyard.



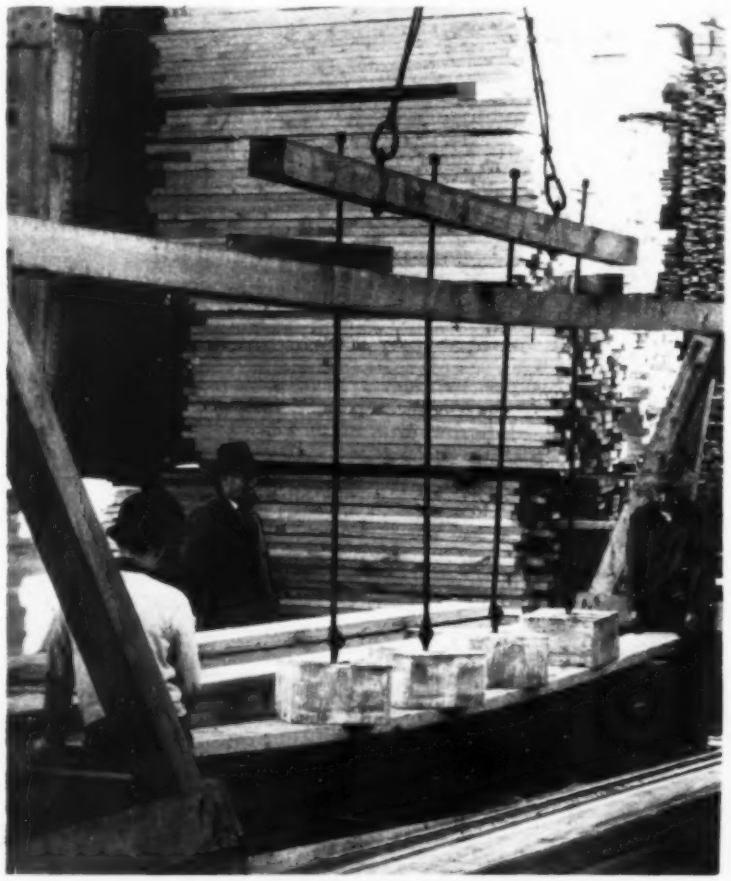
EASE AND SPEED OF ERECTION—and possible dismantling and use elsewhere—were factors in choice of prefabricated wood scaffolding.

SHIPYARD USES *Prefabricated Wood Scaffolding*

PREFABRICATED WOOD SCAFFOLDING of Douglas fir, a development of the Henry Mill & Lumber Co., of Tacoma, Wash., is credited as a major influence in the speedy completion of the new shipyard of the Seattle-Tacoma Shipbuilding Corp. Started Oct. 8, 1939, the shipyard was finished Feb. 15, 1940. The main frame of the loft building was erected in two weeks, and a similar period was required for the shop plate and assembly building. A total of 3,000,000 ft. b.m. Douglas fir lumber went into the general construction of the plant.

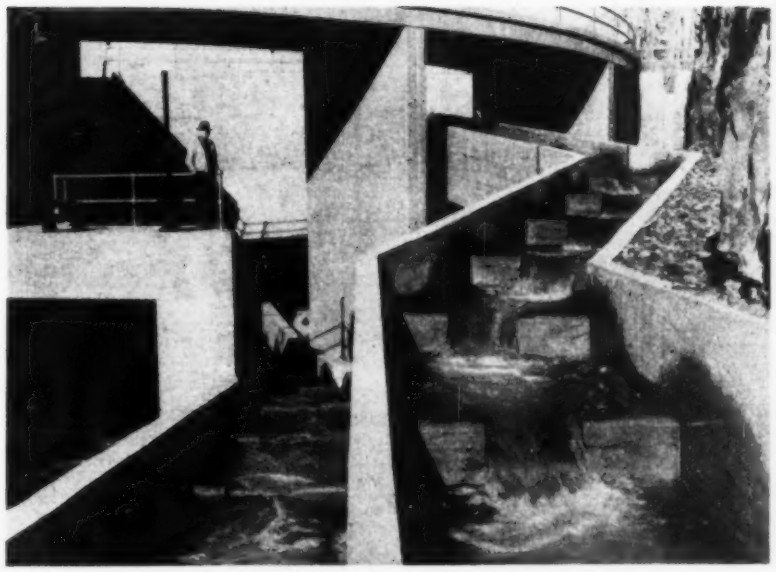
With regard to the scaffolding, the chief requirements included speed and economy of erection coupled with ready adjustability to varying heights to enable welding crews to

(Continued on page 109)



EACH SCAFFOLD PLANK IS TESTED to twice its working load with four 200-lb. concrete blocks and stenciled by state inspector when its strength was demonstrated.

4 MIN. 14 SEC. for complete paint coat **(left)** is record set by 110 painters on nine-room house in Omaha, Neb., breaking earlier mark of 8 min. 30 sec. established in Memphis, Tenn.



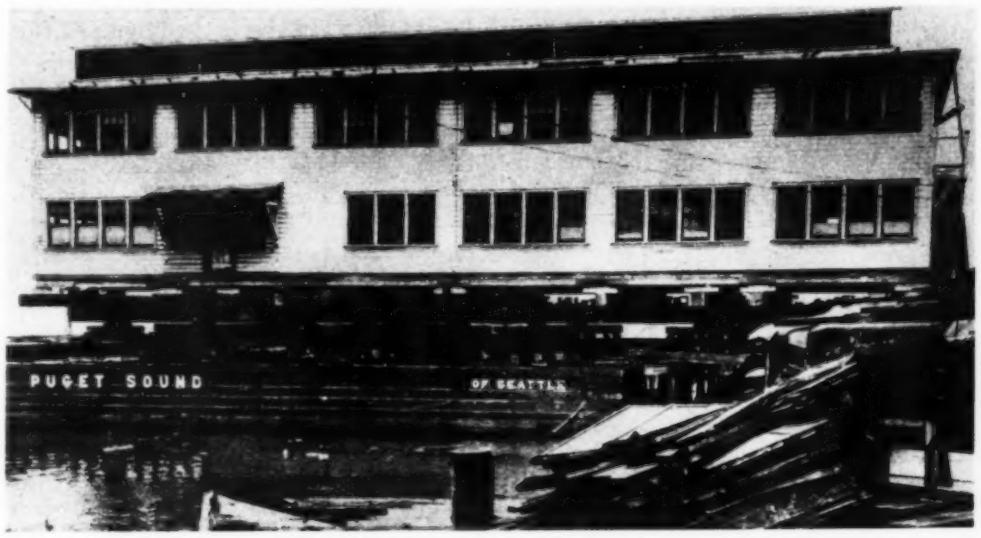
FLUID STAIRCASE. ascending by series of reverse turns from lower left to upper right, helps Yakima River fish over top of Roza diversion dam on Roza division of U. S. Bureau of Reclamation's Yakima project in Washington.

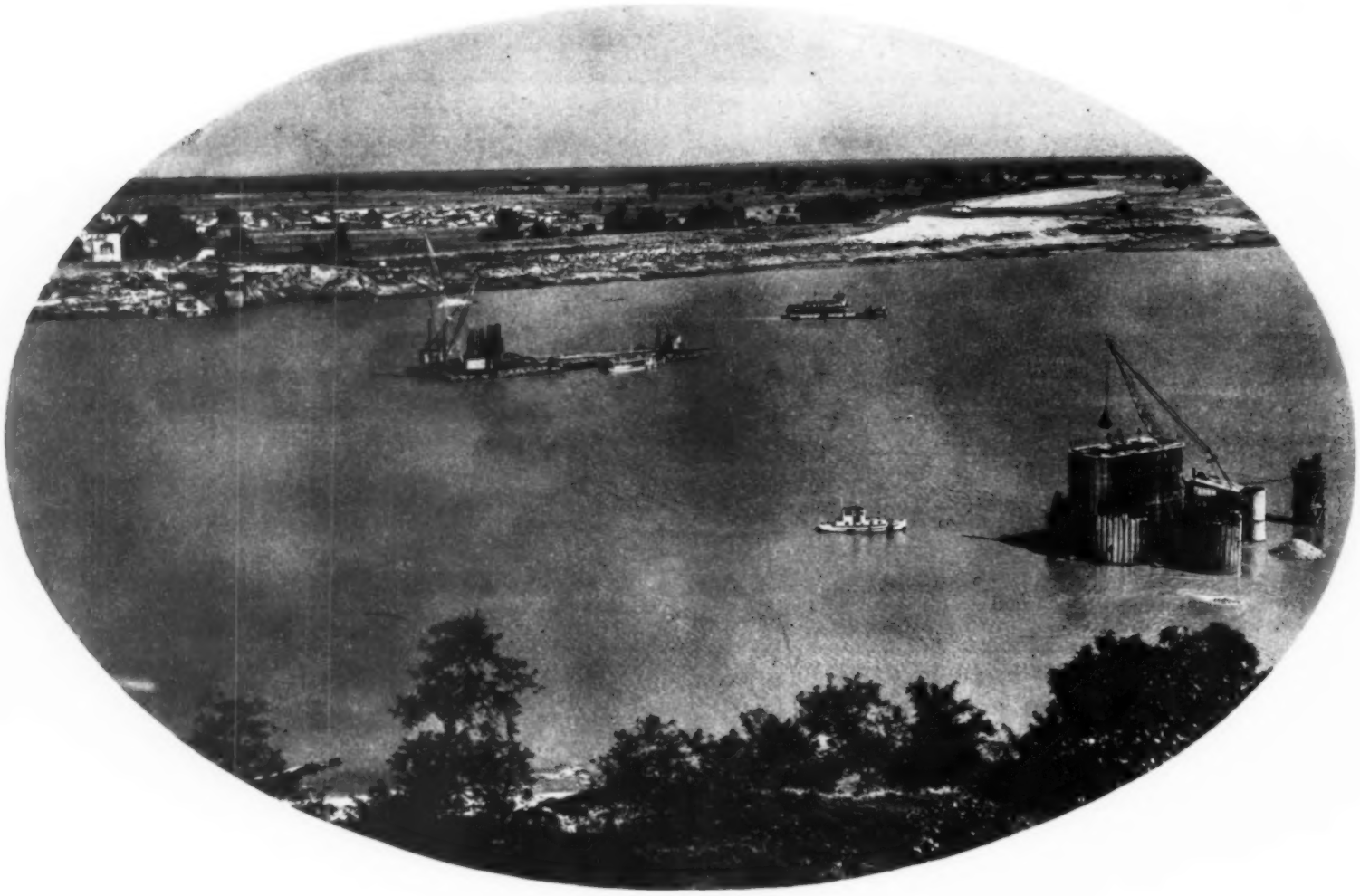
CHIEF FLEETWELD. formerly known to his friends merely as A. F. ("Charlie") Davis, vice-president and secretary of Lincoln Electric Co., Cleveland, studies new chipping hammer with eye of connoisseur during surprise induction into Osage Indian tribe at International Petroleum Exposition, Tulsa, Okla.

odd jobs

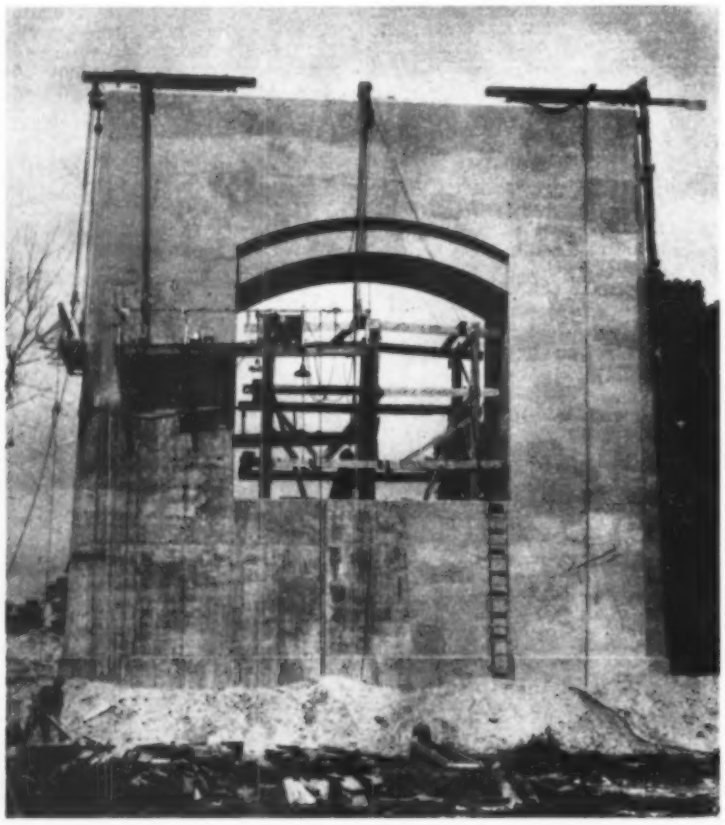
U. S. AND CANADA COOPERATE (below) in bearing down on two-handled shovel to turn first spadeful for new Rainbow bridge replacing ice-wrecked span at Niagara Falls. At right is Thomas B. McQueston, of Ontario, chairman of bridge commission; his partner is Samuel M. Johnson, of New York State, vice-chairman.

BARGE TRIP BY OFFICE BUILDING (below) quickly supplies floor space requirements at new Tacoma, Wash., shipyard of General Construction Co., which jacks up two-story wood-frame structure 23 years old on Seattle waterfront, rolls it on to barge and transports it 40 mi. by water to new location.





MISSISSIPPI RIVER CROSSING at Natchez requires four bridge piers of concrete built with aid of caissons of three types. Pier 1 (in right foreground) is near Mississippi shore while Pier 4 (in left background) is beyond Louisiana shore line, with Piers 2 and 3 intervening.



SHORE PIER NO. 4, on Louisiana bank, is formed by two 26-ft.-diameter caissons sunk 165 ft. by open dredging and connected just below ground level by concrete block supporting pier shaft.

Caissons Sunk In Deep Water

FOR MISSISSIPPI BRIDGE PIERS

CAISSONS OF THREE DIFFERENT TYPES were used by the Dravo Corp., of Pittsburgh, Pa., in constructing four main concrete piers to support a new $2,500,000 bridge across the Mississippi River between Natchez, Miss. and Vidalia, La. Totaling $1,026,000, the Dravo substructure contract covered three piers (Nos. 1, 2 and 3) in the river and one (No. 4) on the Louisiana shore. Pier 4, on the Louisiana shore, consists of two 26-ft.-diameter caissons sunk by the open dredging method to a depth of 165 ft. and connected just below the ground surface by a concrete block on which the pier shaft rests. Piers 1 and 3, in the river near the Mississippi and the Louisiana shores, respectively, were sunk as open dredged concrete caissons in artificial sand islands retained by steel sheetpiling; these caissons were 30x64 ft. in plan and were fitted with steel cutting edges. The Pier 1 caisson was carried to a depth of 80 ft. and the Pier 3 caisson to a depth of 125 ft. The outstanding feature of the job, however, was the caisson for Pier 2 in midstream, where current velocity was 7 m.p.h. As described by H. L. Hood, of the contractor's

organization, the methods employed at this pier, involving the placing on river bottom of a 250x400-ft. timber mattress and the use of a Dravo standard steel floating caisson, were as follows:

As a preliminary to sinking the caisson for Pier 2, a typical Mississippi River timber revetment mattress, 250 ft. wide and 400 ft. long, was built, sunk and anchored on the river bottom in 80 ft. of water over the pier site.

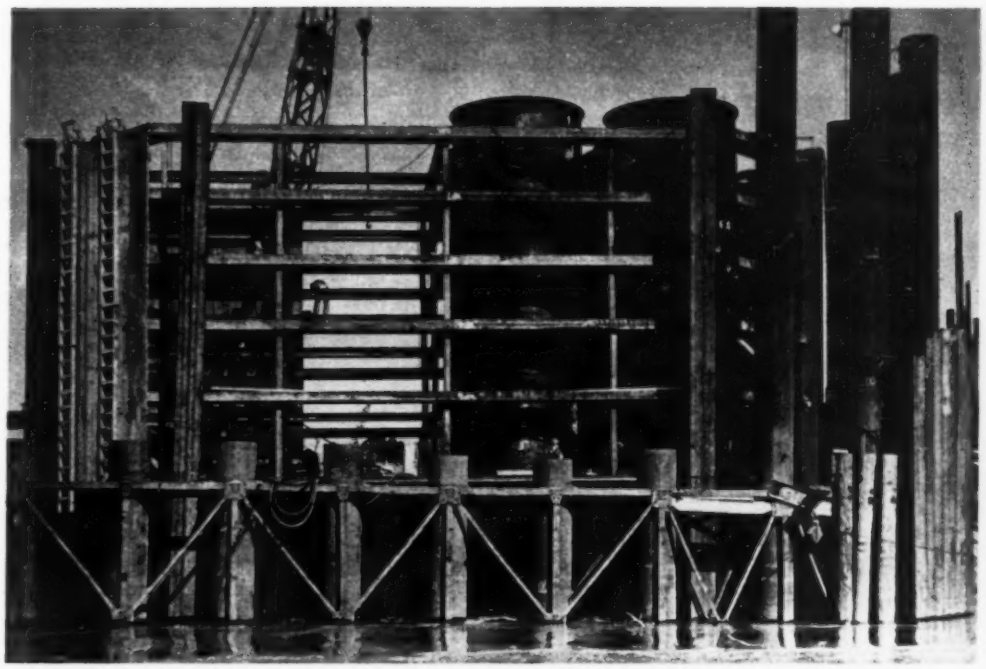
The caisson for Pier 2 was 31x64 ft. in plan and 20 ft. high; it carried eight dredging tubes, each 11 ft. in diameter. Built at the contractor's shops on Neville Island, near Pittsburgh, it was equipped with a wood false bottom and towed 1,680 mi. to the Mississippi River bridge site. The problem was to land it accurately on the river bottom in swiftly flowing water 80 ft. deep.

The floating caisson, with sides 20 ft. high, had a draft of 7 ft. Before very much concrete could be placed inside to build up the walls, it was necessary to extend the sides with 6x12-in. tongue-and-groove sheathing braced on the inside with steel frames to withstand the water pressure. As the sides were built up and concrete placed, the 11-ft.-diameter dredging tubes also were extended simultaneously so that the top of the caisson was always above water.

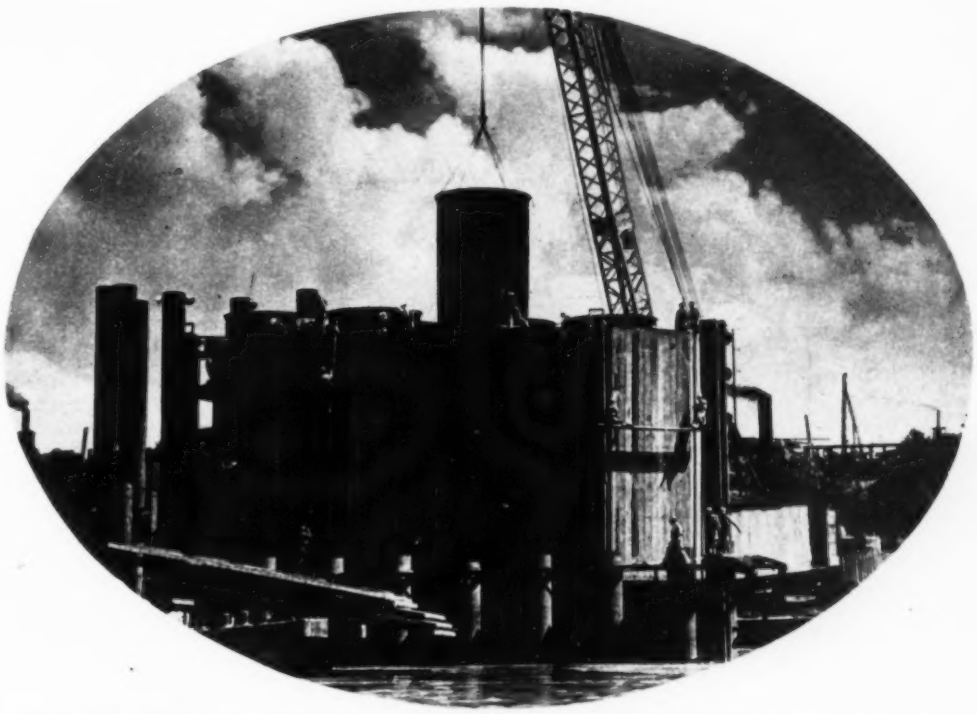
Protective "Stall"

Caissons of this type, Mr. Hood points out, are usually held in position during sinking by cables and anchors but in this case, to minimize risk of breaking away, another method was employed. A steel framework was designed and constructed with a depth of 40 ft. and in the general form of a horseshoe. It consisted of two parallel frames each about 6 ft. wide and 40 ft. deep, thoroughly braced and curved at the upper end so as to form a semicircular frame connection. In this frame, and spaced 6 ft. on centers, were formed guides that would take 36-in.-diameter pipes or cylinders. These cylinders were driven to refusal and filled with sand, thus forming spud anchors for holding the frame in position and, due to the bracing in the steel framework, the entire

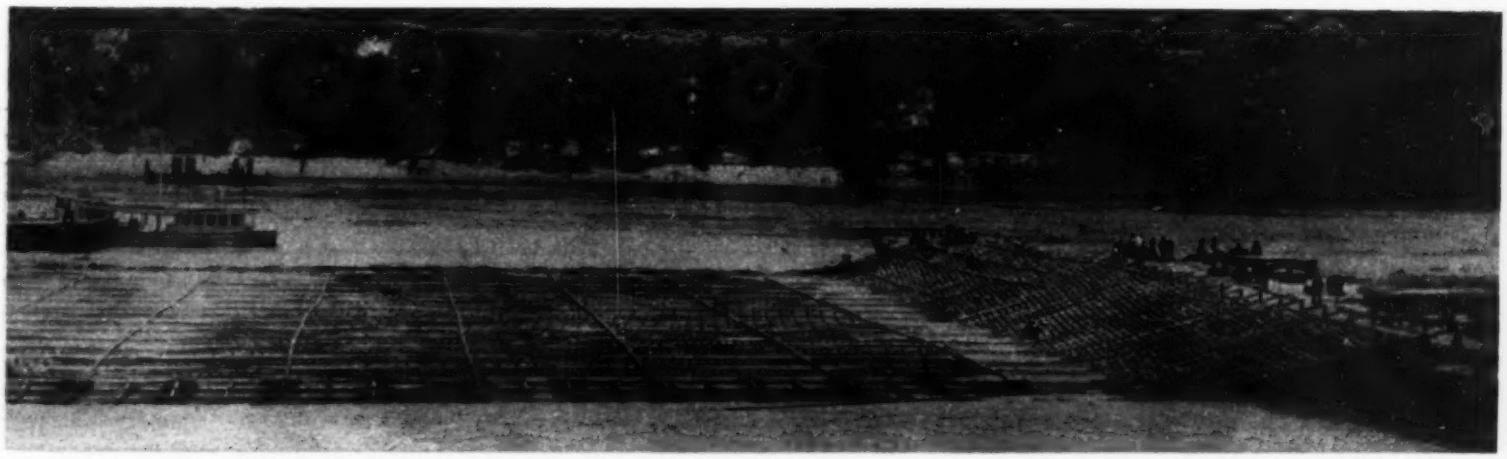
(Continued on page 102)



PROTECTIVE "STALL" of steel framework and steel sheetpiling was built to shield caisson for Pier 2 from swift river current during sinking. Ring of 36-in. steel pipes, driven into river bottom and filled with sand, serve as spud anchors. Behind them are 11-ft.-diameter dredging tubes.



FLOATING CAISSON for Pier 2 is held within its protective "stall" as wood sheathing is extended on sides and 11-ft.-diameter dredge tubes are being placed.



WOVEN TIMBER MATTRESS, measuring 250x400 ft., is launched from barge prior to sinking on river bottom over site of bridge pier.

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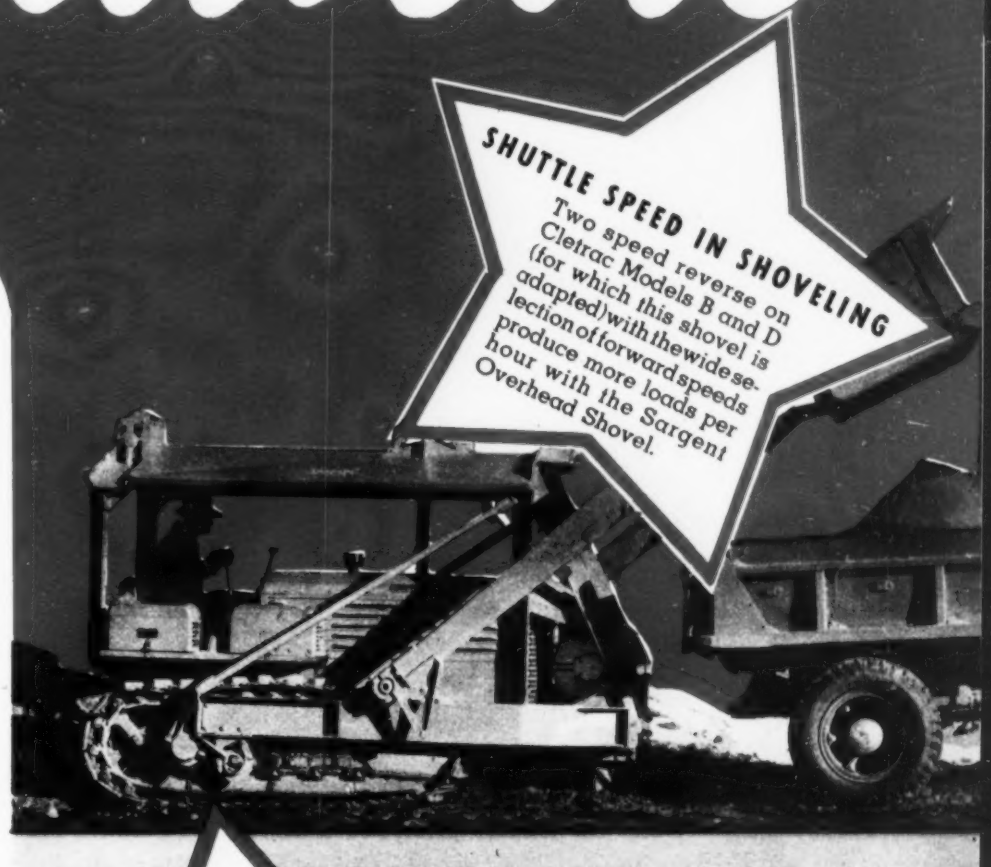
4. Easier service and quicker adjustments for motor, clutch, steering and track.
5. Electric—easier starting tractors.



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Two speed reverse on Cletrac Models B and D (for which this shovel is adapted) with the wide selection of forward speeds produce more loads per hour with the Sargent Overhead Shovel.

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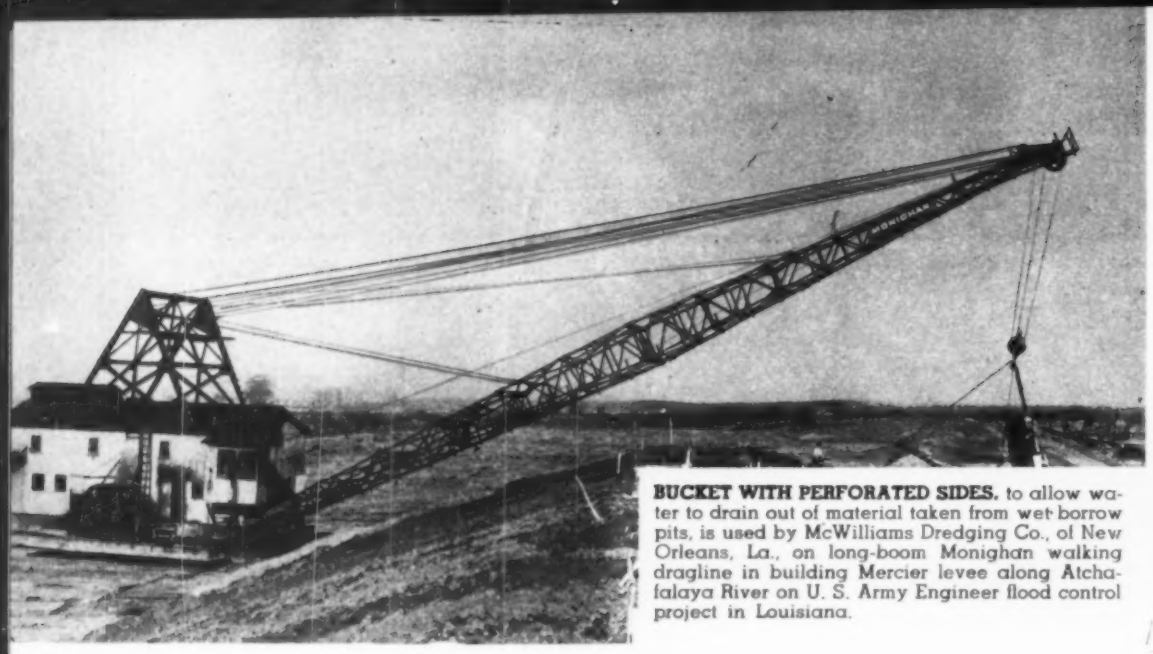
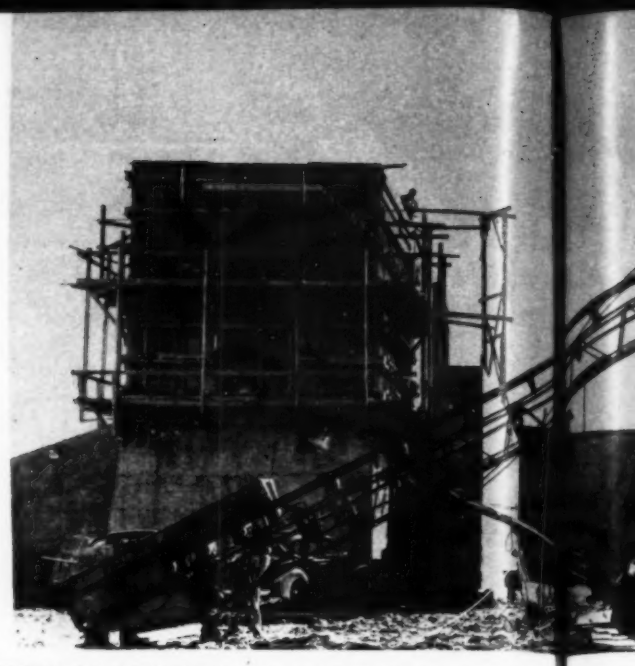
A COMPLETE LINE OF

CLETRAC CRAWLER TRACTORS



BUCKET WITH PERFORATED SIDES, to allow water to drain out of material taken from wet borrow pits, is used by McWilliams Dredging Co., of New Orleans, La., on long-boom Monighan walking dragline in building Mercier levee along Atchafalaya River on U. S. Army Engineer flood control project in Louisiana.

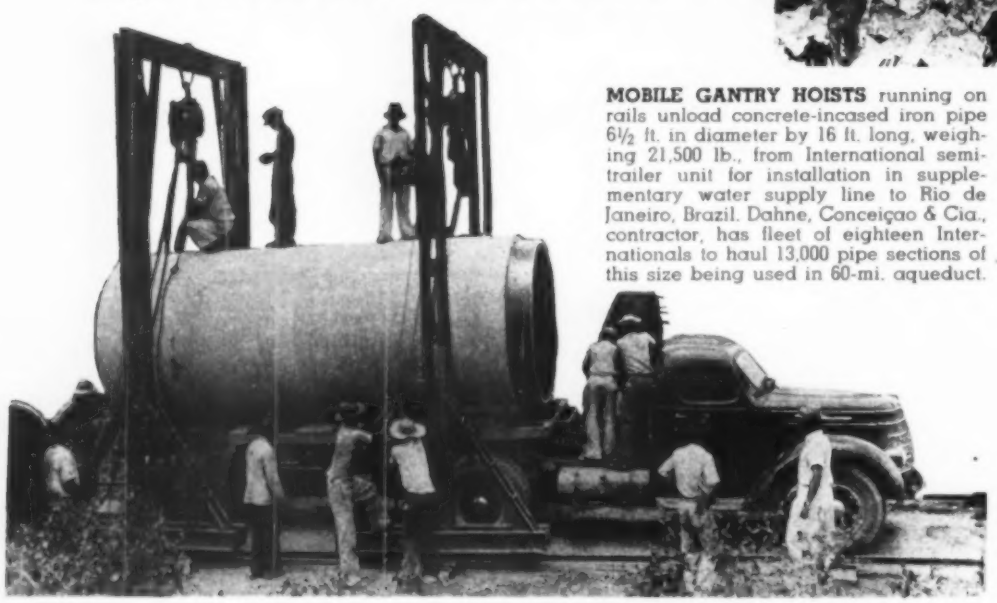


DELIVERY OF CONCRETE to top of wall forms for cutoff wall and control house at Hansen dam, U. S. Engineer Department flood control structure in southern California, is handled by inclined belt conveyor. Wheel mounting enables rig of Guy F. Atkinson Co., contractor, to be moved

HOW

CONSTRUCTION DETAILS

For Superintendents and Foremen



MOBILE GANTRY HOISTS running on rails unload concrete-incased iron pipe 6½ ft. in diameter by 16 ft. long, weighing 21,500 lb., from International semi-trailer unit for installation in supplementary water supply line to Rio de Janeiro, Brazil. Dahne, Conceiçao & Cia., contractor, has fleet of eighteen Internationals to haul 13,000 pipe sections of this size being used in 60-mi. aqueduct.

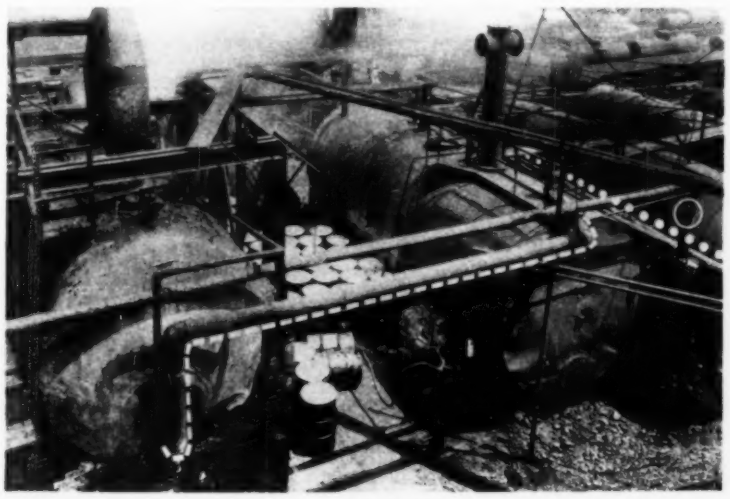
TRACTOR CRANE handles rock placed by Northwestern Engineering Co., Rapid City, S. D., contractor, in 24-in. riprap cover totaling 18,000 cu.yd. which protects reinforcement fill of earth and gravel added to upstream face of Belle Fourche dam, U. S. Bureau of Reclamation structure in South Dakota, to improve stability and eliminate any risks connected with rapid draw-downs in dry years. Empty reservoir in fall of 1939 aids placement of fill and riprap.

TWENTY DRILLS SPACED 5 FT. APART along one side of **Hornet II (below)** enable Al Johnson Construction Co. and LaCrosse Dredging Co., Minneapolis, contractors, to drill 100-ft. row of holes without changing position of equipment on $958,000 TVA dredging job, downstream from Pickwick dam, removing 330,000 cu.yd. of ledge rock to provide navigation channel 11 ft. below low water for 9-ft.-draft boats. Drills used include sixteen Ingersoll-Rand DA-35 drifters and two N-75 drifters, in addition to four older machines; all drills are mounted on 170-lb. slab-backs.

TAMPING-SPREADING FINISHER adapted to slope paving is used by U. S. Engineers directing hired labor in placing hot asphalt pavement on Westwego-Gretna levee, Mississippi River, opposite New Orleans. Special hopper on Barber-Greene machine is loaded by crane with truck-hauled hot mix.

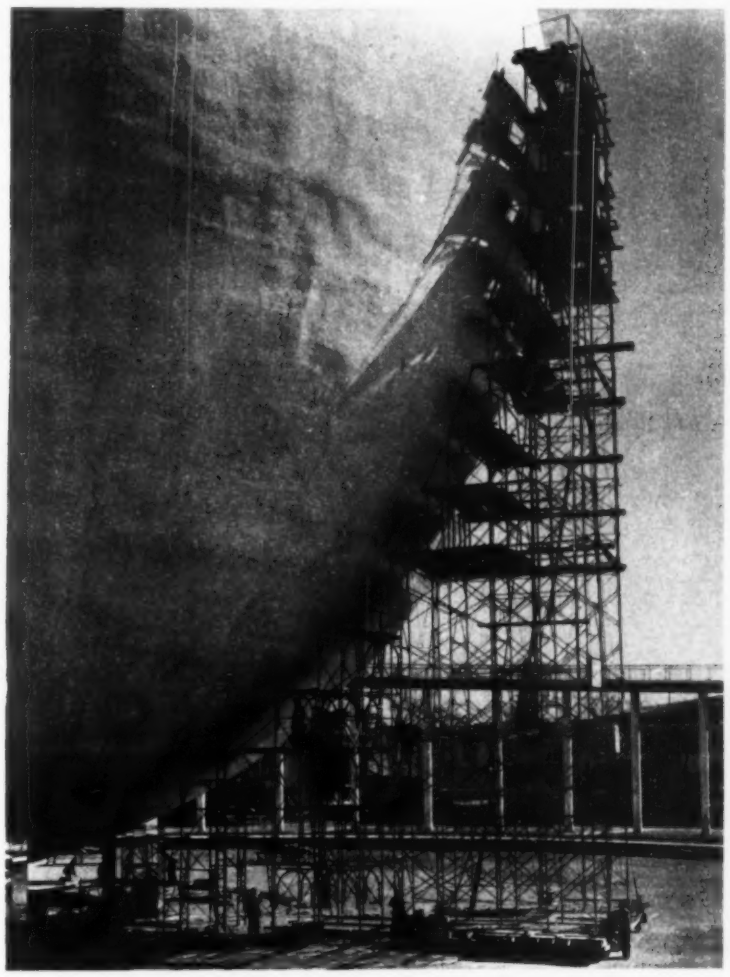
laterally as forms are filled. Cables to hand winch on gallows-frame above wheels provide quick means of adjusting delivery end of conveyor to desired height. Col. E. C. Kelton, Corps of Engineers, is district engineer in charge of project.

TWO-LEVEL PROFILE of divided highway constructed by utilizing old pavement, at left, and adding second roadway, at right, built to modern gradients and alignment, requires special treatment of steep fill slopes in dividing strip, here protected by laminated timber guard rail on California Division of Highways project completed by Matich Bros., contractor, between Colton and Riverside. Concrete curbs of recessed panel type are used along median strip for greater visibility by night.



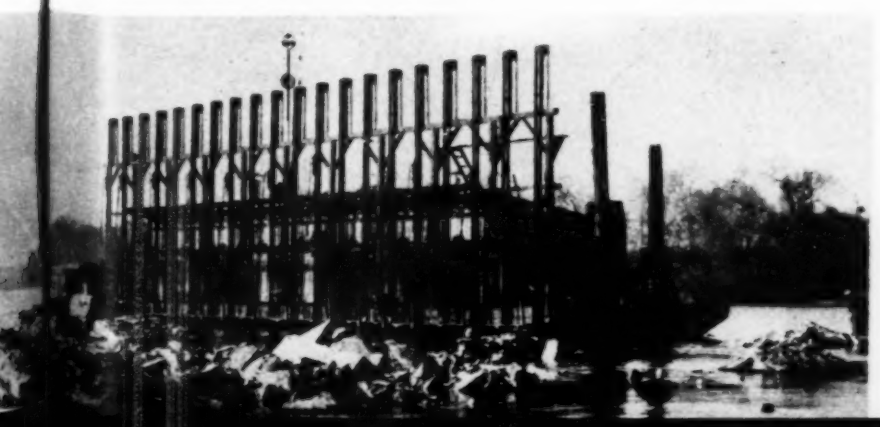
ELECTRIC HEAT maintains free flow of asphalt through 600 ft. of unloading pipe draining tank cars into two stills at Byerlite Corp.'s asphalt products plant, Cleveland, Ohio. General Electric calrod units spiralled in about 2½-ft. spirals along 600 ft. of pipe and covered by sheet metal and ample heat-insulating material provide uniform temperature throughout line, units being automatically controlled by thermostats. Series-parallel connection of heating element affords flexible control. Installation reduces unloading costs and time, thus greatly increasing output.

THREE-PRONG TONGS, made on job, lift rock fragments larger than two-man size and weighing up to 1,000 lb. for paving outlet channel of control works at Prado dam, U. S. Engineer Department flood control project in Southern California. Devised by J. B. Stringfellow, subcontractor on paving job, tongs are made of light steel shapes and are operated by small crawler crane. Double prongs are stiffened by welded horizontal steel bar. Crane hook is attached to chain connecting upper ends of prongs and when lifted assures solid grip on stone.

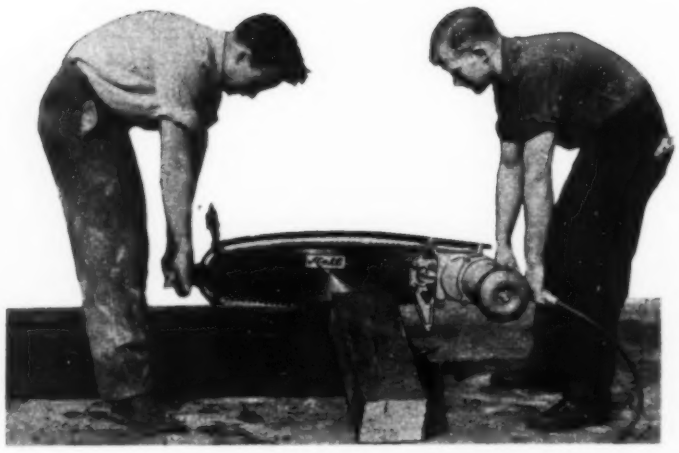


ROLLING SCAFFOLD 92 FT. HIGH, said to be tallest mobile scaffold ever put together, is erected by Safway Steel Scaffolds New York, Inc., of welded tubular Safway steel scaffold units assembled and guyed in accordance with engineering plans developed by Purdy & Henderson, consulting engineers, New York, to assist J. I. Hass Co., contractor, New York, in painting lower half of 180-ft.-diameter Perisphere at New York World's Fair. Tall scaffold rests on timber platform mounted on 36 solid-rubber-tired steel casters. Two hand winches at forward edge of platform move scaffold from one position to next. Third hand winch, at rear, is used to make radial adjustment in position of scaffold.

ROLLER CRADLE (below) suspended from derrick attachment on Caterpillar tractor supports pipe line for operation of pipe traveling machine during construction at rate of as much as 11,000 ft. in 8-hr. day by O. C. Whitaker Co., contractor, for Magnolia Petroleum Co., on line from St. Louis to Lima.



SMALL TOOLS ON CONSTRUCTION



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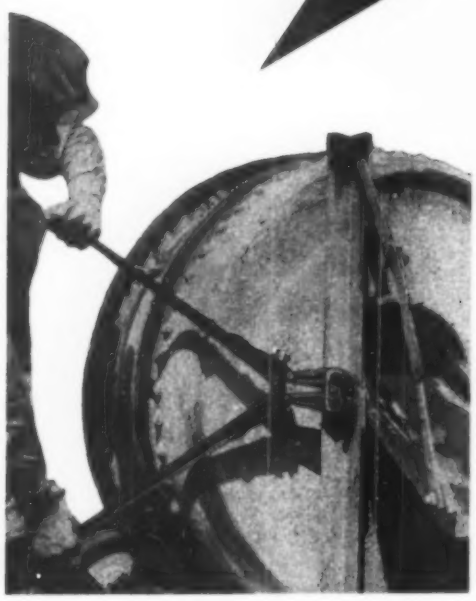

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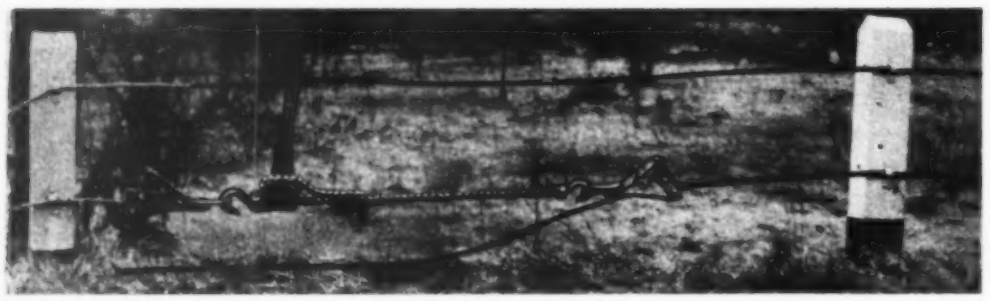


6

1 **CHAIN SAW** powered by 1½-hp. electric motor has cutting capacities of 24 and 36 in. New Mall unit operates on 110- and 222-volt a.c. or d.c. current. Saw teeth have permanent set which is not destroyed by sharpening. Replacement chains can be installed in field without special tools.

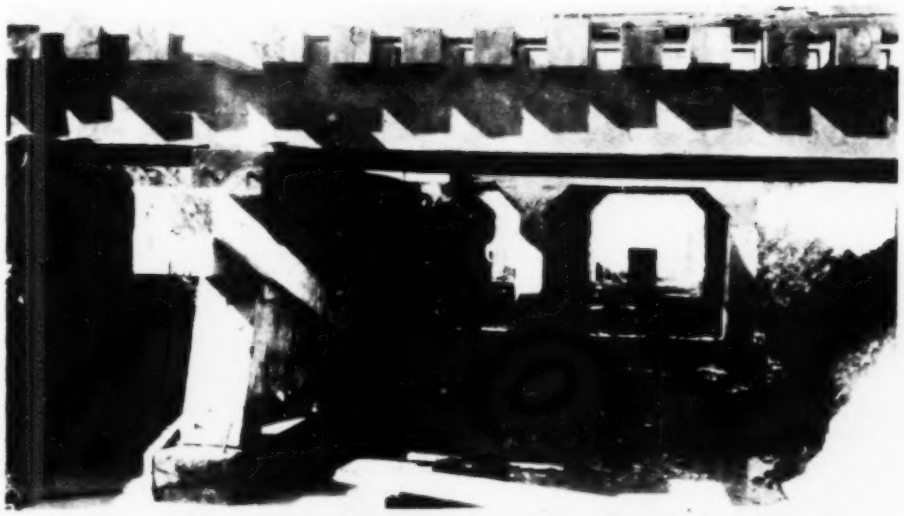
2 **SIDE NUT SPLITTER** is available in both rigid and swivel types. Cutting edges of this tool (H. K. Porter) remain separated sufficiently, after making cut, to prevent damage to bolt. Adjustable for two capacities. Useful in dismantling or demolition work.

3 **CORRUGATED SHEETS** of asbestos-cement composition, product of the Keasbey & Mattison Co., are readily bored with ordinary electric hand drill when installation requirements demand holes through this hard material.

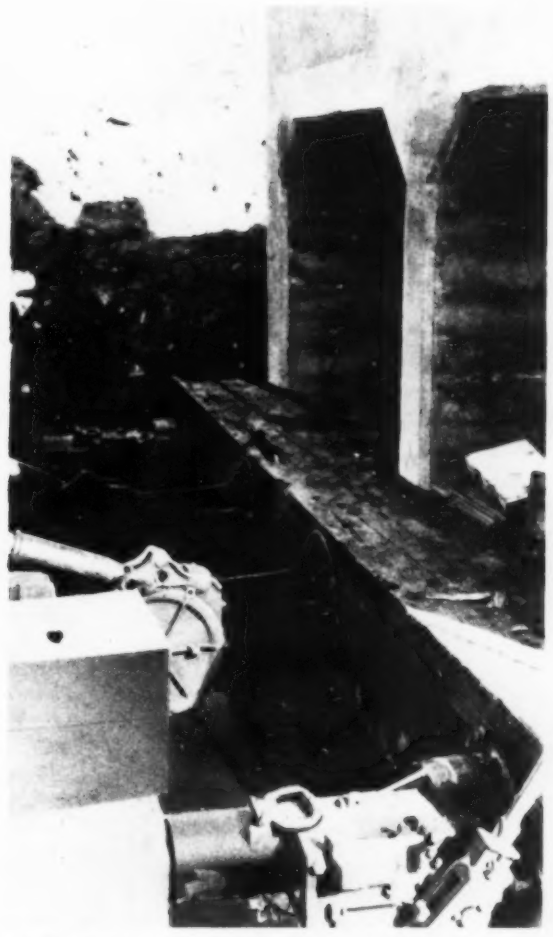
4 **PORTABLE POWER PLANT,** comprising electric generator driven by gasoline engine, operates wood auger on track maintenance work for New Haven Railroad. Nickel alloys, both cast and wrought, enter prominently into the construction of these Homelite engines.

5 **PUNCHING HOLES** for ¾-in. rivets in flange of 10-in., 40-lb. H-beam is quickly accomplished with this velocity-power portable punch (Mine Safety Appliances Co.) Tool averaging 30 to 40 holes per hour utilizes gas pressure generated through discharge of blank cartridge as source of energy. C-clamp serves to position power head accurately. Cartridge is discharged by blow from hand-operated firing hammer. Gas pressure drives punch through steel plate section clamped in tool frame.

6 **FOR TIGHTENING CABLE** on highway guard-rail pull-hoist (Colfing) operated by ratchet lever and pawl proves to be an effective tool. Unit weighs 25 lb. and exerts pull of 1½ tons. Standard length of lift is 56½ in. Load is always locked—cannot slip.



OLD TIMBER TRESTLE carrying railway tracks was removed to make way for new precast concrete culvert seen in background.



FOUR JACKS spiked to 8x16-in. cross timber were used to shove 66-ton precast concrete box culvert horizontally into place.

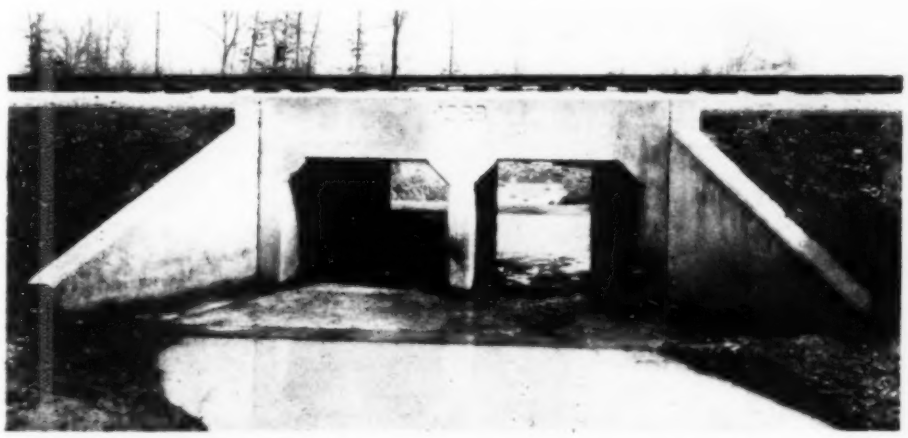
Jacks

Push Culvert Into Place Under Railroad

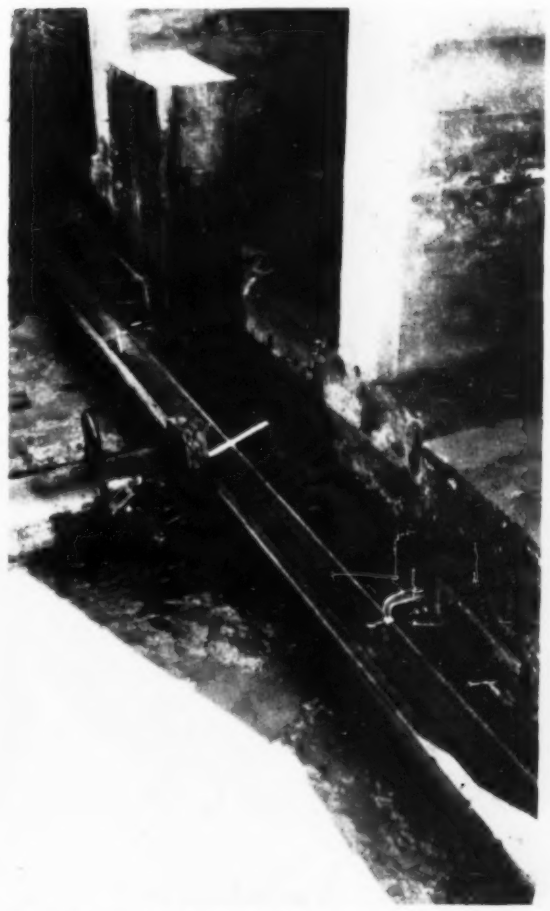
JACKING METHODS made it possible for the Missouri Pacific Railroad to replace in 105 min. an old two-panel timber trestle with a new double 4x5-ft. precast concrete box culvert 22 ft. long at Gold Creek, Ark. The invert of the new culvert was 6 ft. 1 in. below base of rail. As described by A. B. Cheney, the railway's designing engineer, the method employed caused no interruption to traffic and also avoided the necessity of raising the track 16 in., constructing a temporary bent, allowing time for poured-in-place concrete to harden, removing old stringers and lowering track on to the new culvert.

Tests indicated that to move the new culvert, weighing 66 tons, into place would require a jacking force of 23 tons. Skids or liners of second-hand 8x16-in. stringers, faced on top with galvanized iron smeared with soap, were set on 8x16-in. cross-pieces or ties 14 ft. long on the ground to provide a track on which the new culvert could slide. Against a substantial backstop four jacks were set horizontally; they included two 50-ton Norton geared jacks (one above each skid) and, between these, two 35-ton

(Continued on page 102)



JACKED INTO PLACE with low headroom, new precast concrete culvert is double 4x5-ft. unit with invert 6 ft. 1 in. below base of rail.



NUMBER AND SIZE OF JACKS was determined in advance of actual jacking by testing deflection of 90-lb. rail under load considered necessary to shove culvert.

HIGHWAYS FOR DEFENSE

A statement by
COL. LOUIS JOHNSON, *Assistant Secretary of War*

AN INDICATION of the importance the United States Army attaches to highways is comprehensively expressed by Col. Louis Johnson, Assistant Secretary of War, in the statement below, prepared expressly for *Construction Methods*. Transport is a vital factor in industrial mobilization, which is Col. Johnson's major responsibility. Here are Col. Johnson's views:

"In a program for effective national defense highways of modern design, strategically located, serve a vital need in providing means of rapid transport for men, equipment and supplies between centers of military or industrial importance. The construction industry is making a timely contribution to preparedness by building, as parts of a predetermined system of arterial routes, more and better roads. Not only will these paved routes insure mobility for military purposes in time of emergency but they will also constitute an essential aid to industrial production, which must depend upon adequate highway transport for expediting deliveries of the vast quantities of raw materials, parts and finished products required for national armament."

Working Day and Night

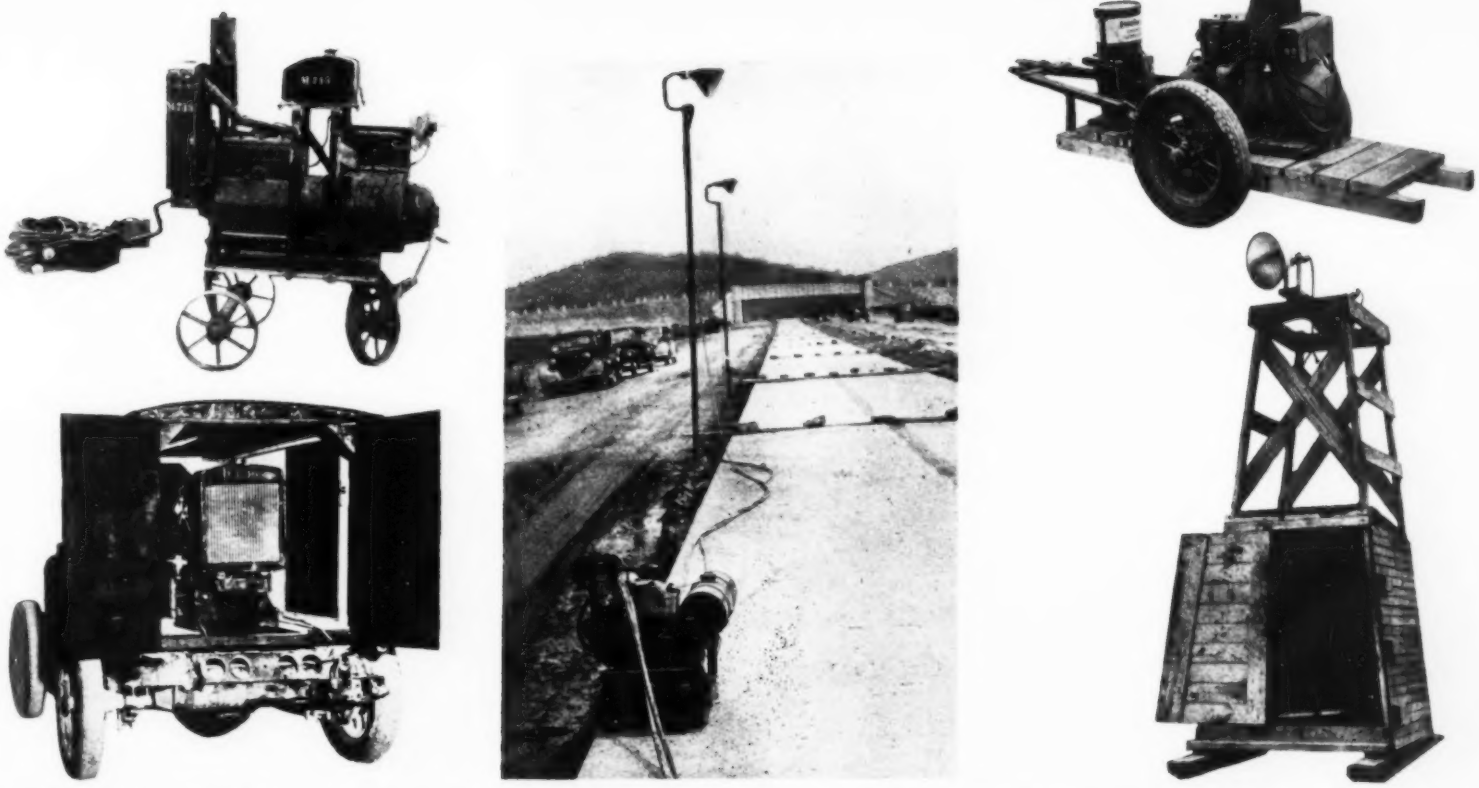
25 Paving Outfits Place 2,000 Cu. Yd. per Hour

In Pennsylvania Turnpike Slab

ON INTO NIGHT. three-shift operations of John F. Bloomer, Appleton, Wis., continue placing and finishing concrete to full 24-ft. roadway width, aided by strings of electric lights mounted on T-iron fence posts.

GEARED TO LAY FOUR 12-FT. LANES of 9-in. uniform thickness reinforced-concrete pavement at a rate of 2½ mi. per 24 hr., working night and day, during May and to step up this progress to 3 mi., or more, per day during June, the Pennsylvania Turnpike Commission and its 21 paving contractors (holders of contracts for a total of 29 sections), began their final construction month May 29 with confidence that 30 days of good weather would prove sufficient to complete the pavement from end to end of the 160-mi. express toll highway between Harrisburg and Pittsburgh. Hopeful that a dry June would even the weather score after a wet, cold spring, the contractors and field engineers pushed the job on a day-and-night schedule with full determination to pave the entire route by the stipulated completion date of June 29. On a basis of the paving capacity already exhibited by the 25 outfits then operating, the expectation of early completion was well founded.

In the 25 outfits of 19 contractors laying slab during the week ending May 25 were 35 mixers—eighteen 34E dual-drums, three 27E dual-drums and fourteen 27E single-drums—making up in all a battery of mobile production units capable of laying down 2,300 cu.yd. of concrete per hour at 90 per cent operating capacity, with full allowance for the 75-sec. mixing requirement and for the severe transfer and charging time penalties exacted by the Turnpike Commission. As every cubic yard equals 4 sq.yd. of 9-in. uniform thickness pavement, this volume of concrete was sufficient for 9,200 sq.yd. of slab, disregarding overrun. Because an overall efficiency of 90 per cent is beyond the bounds of possibility for 25 paving out-



VARIETY OF LIGHT PLANTS serves contractors for night illumination on Turnpike, as indicated by these examples of portable units up to 5,000-w. capacity, some of them **(bottom, left)** on salvaged chasses of old trucks and automobiles: **(top, left)** 5,000-w. 115-v. generating set on three-wheel truck is one of several light plants used by Union Paving Co., Philadelphia, contractor for three adjoining sections totaling nearly 14-mi.; **(top, right)** converted concrete cart serves as carriage for 1,500-w. plant on one of W. L. Johnson Constuction Co.'s contracts, where lighting lines are strung with waterproof cable in 100-ft. sections; **(bottom, right)** skid-mounted light tower on John H. Swanger contract carries housed-in 800-w. generating set and two 300-500-w. floodlamps; **(center)** 1,250-w. 120-v. unit, equipped with handles for carrying by two men, furnishes power to lamps mounted with reflectors on pipe posts by County Construction Co.

fits, it is safer to assume 70 per cent of this potential production (equal to 63 per cent of maximum capacity), which gives a reasonably attainable figure of 6,440 sq.yd. per hour. At this rate, the paving crews could complete slightly more than 90,000 sq.yd. in two 7-hr. shifts, the minimum working day on any of the contracts. This yardage is equivalent to 3.2 mi. of four-lane pavement, with an overall width of 48 ft.

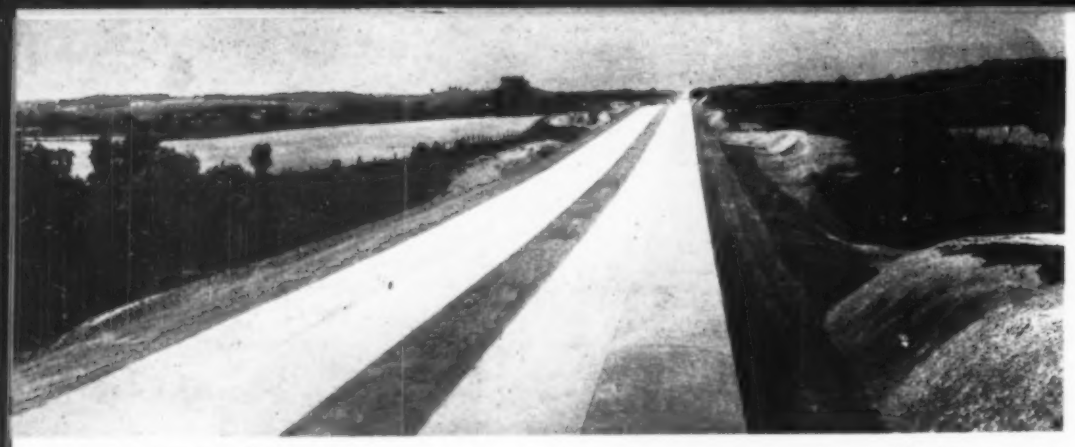
As a matter of fact, as early as May 10 the nineteen contractors then operating had placed 70,841 sq.yd., equivalent to 2.51 mi. of four-lane pavement, in a single day. Frequent rains during the remainder of the month made it impossible to maintain this daily progress, but on May 29 the pavement was more than 40 per cent completed, of which about 8.25 per cent had been placed last fall, leaving roughly the equivalent of 90 miles of four-lane pavement to be completed in the final month of construction.

During the wet week ending June 1, the contractors paved the equivalent of 7.6 mi. of Turnpike, and in the following week, to June 8, they added 16.9 mi. On the latter date, 84.55 mi. of equivalent four-lane paving had been completed, and 68.31 mi. remained to be paved.

It was planned to accelerate progress during June by adding third shifts where necessary and by permitting contractors as they completed their own sections to move their paving outfits on to adjacent uncompleted sections.

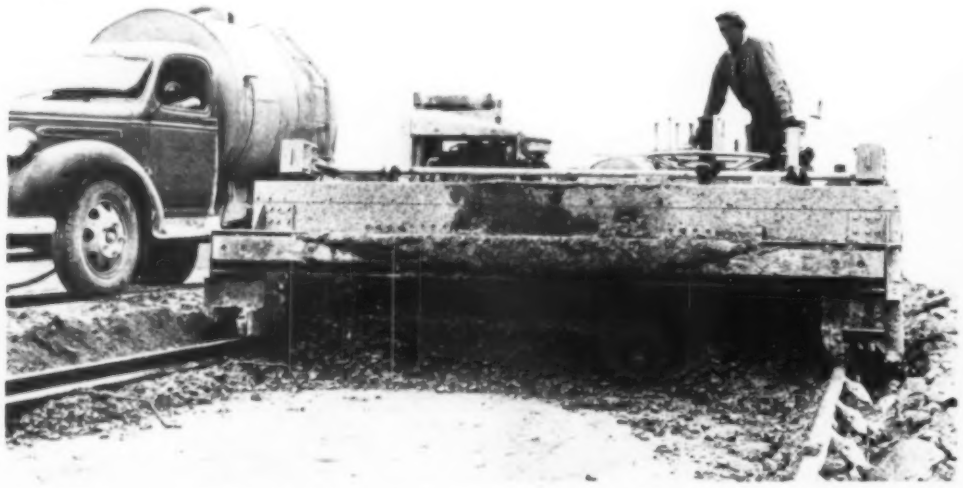
For its entire length, the Turnpike is

TWO TYPES OF CONCRETE SPREADERS. reversible screw type for 7-in. layer and transverse blading type for 2-in. top course, work in conjunction with 34E dual-drum mixer and 27E single-drum follower paving 12-ft. lane on 9.6-mi. contract of County Construction Co., Carnegie, Pa. As 27E catches up with 34E, large paver pulls ahead, leaving gap in 7-in. layer to be filled by smaller mixer. This outfit completes as much as 5,208 lin.ft., equal to 6,944 sq.yd., in two shifts. Combinations of dual-drum and single-drum pavers are used by at least eight contractors, although not ordinarily with double spreaders.

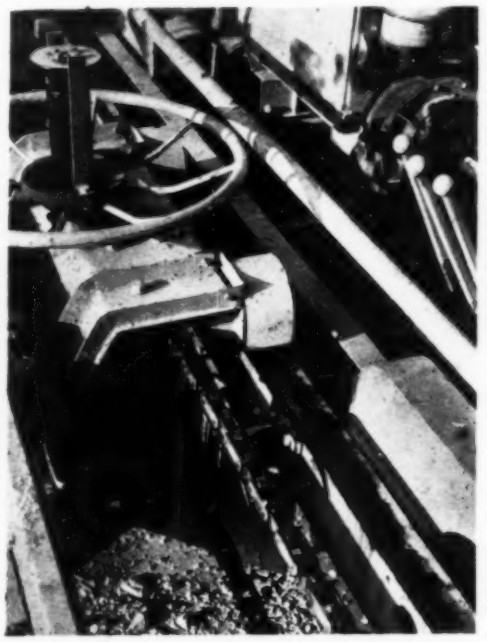


12-MILE STRAIGHTAWAY, longest stretch *free* from curves on trans-mountain toll highway, invites motorist to step on accelerator as he courses westward through Cumberland Valley toward Blue Mountain, in distance. Four 12-ft. lanes separated into two roadways by 10-ft. center strip are typical of highway design for 160 mi. of route except in seven tunnels, totaling 6½ mi. in length, where pavement reduces to two lanes.

MULTI-PURPOSE TRAILER transports wet burlap mats used for 24-hr. curing (followed by 48 hr. under waterproof paper) on one of W. L. Johnson Construction Co.'s three separated sections, totaling 9¾ mi. Trailer is equipped with rails on 12-ft. centers for moving equipment (subgrader, concrete spreader, finishing machines and mechanical longitudinal float) operated on steel road forms.



NEW-TYPE CONCRETE SPREADER is equipped with pivoted blade which moves transversely in machine to spread concrete laterally across 12-ft. lane on two adjacent contract sections, totaling almost 6 mi., of Walker Bros. Chambersburg, Pa. Troweling action of spreader blade avoids segregation and reduces load on strikeoff plate. Both blade and strikeoff are readily adjusted by operator for two-course work.



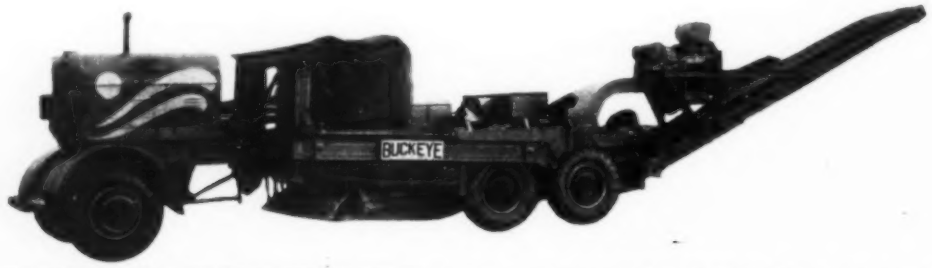
CHAIN DRIVE moves pivoted spreading blade transversely in concrete spreader. Single power plant operates blade and propels machine through unit-type transmission affording independent lever control of all motions.

OLD SOUTH PENN R.R. CUT (below) on right-of-way serves N. B. Putman, Harrisburg, Pa., contractor for two adjacent sections totaling 8 mi. in length, as admirable location for hillside drive-through plant batching dry materials for 34E paver. In size and hillside location, this plant is representative of many used by paving contractors on project. For 39 mi. of its 160-mi. length, Turnpike follows line of old South Penn R.R., partially constructed at cost of $10,000,000 in 1880's and then abandoned.

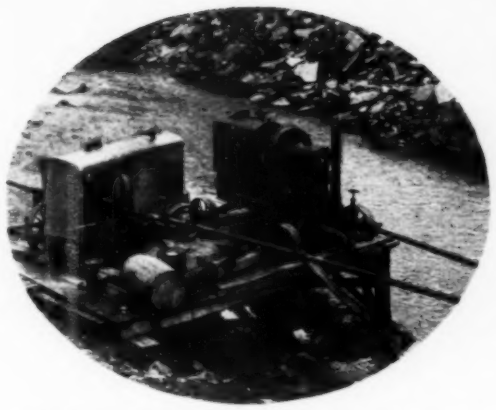
CONCRETE IS BANKED (above) against edge form with turning movement of hand shovel, as required by specifications, in advance of screw spreader on 6.7-mi. contract section of John H. Swanger, Lancaster, Pa., whose contract includes grading and structures as well as paving. Two 1,000-gal. tank trucks, one of which appears in right background, supply water to 34E dual-drum paver, in accordance with practice followed by most Turnpike contractors.

free from intersections at grade. Maximum grade is 3 per cent, and all maximum curves (6-deg.) are confined to a single 6-mi. section. Only eight other curves are sharper than 4 deg. All curves are superelevated, and spiral easements are used for curves sharper than 2 deg.

With the exception of seven tunnels totaling 6.7 mi. in length through mountain ridges in which the highway reduces to a 23-ft. paved width, the remaining 153 mi. of highway has a 78-ft. graded section carrying two 24-ft. roadways separated by a grassed 10-ft. center strip. Definite assurance could be



PNEUMATIC-TIRED FINE-GRADING MACHINE of new type is operated by Baldwin Bros. Paving Co., Cleveland, on 4¼-mi. section at western terminus of Turnpike. Wet weather has caused temporary cessation of activity, but, when operating, material fine-graded by reciprocating digging teeth is gathered by angle blades into chain scraper loader which delivers spoil to conveyor at rear end.



PAIR OF TRIPLEX PUMPS connected into 3-in. line fitted with Dresser couplings supplies water for mixing and curing on 5.9-mi. contract of Mid-West Construction & Asphalt Co., Chicago, Ill. These pumps are capable of maintaining a pressure of 450 to 500 lb. per square inch.

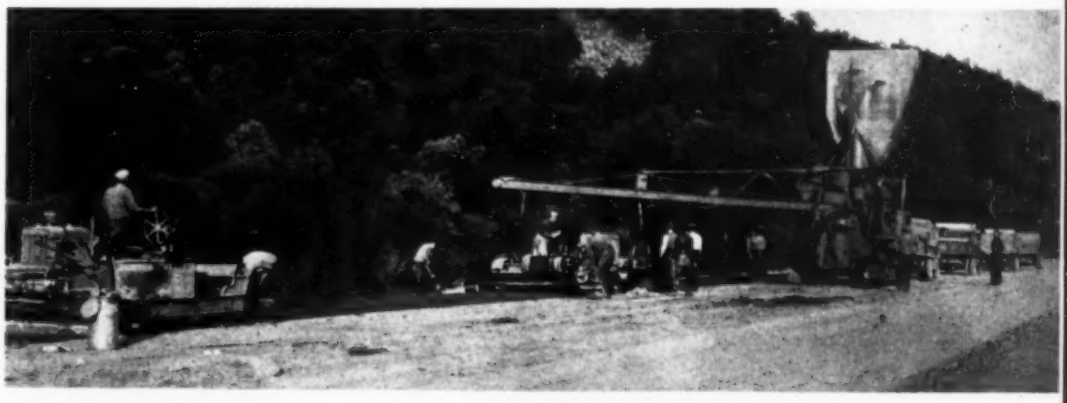
given by Richard M. Merriman, chief engineer of tunnels, that all pavement in the seven bores would be ready for traffic by July 4. Included in the 29 paving contracts on the open highway are 4,334,189 sq.yd. of 9-in. reinforced slab.

Average cost of paving and incidental work for a mile of turnpike is about $98,000. Slab unit prices range from $2.35 to $3.10 per sq.yd., with $2.70 being about the average figure. At this average unit price, a mile of four-lane reinforced slab costs a trifle more than $76,000. Materials haulage is the principal factor accounting for the difference in slab unit prices. Some jobs are near railroads and main highways, while others involve 10- to 12-mi. hauls from rail delivery points to batching plants, in some cases over specially constructed or reconditioned haul roads.

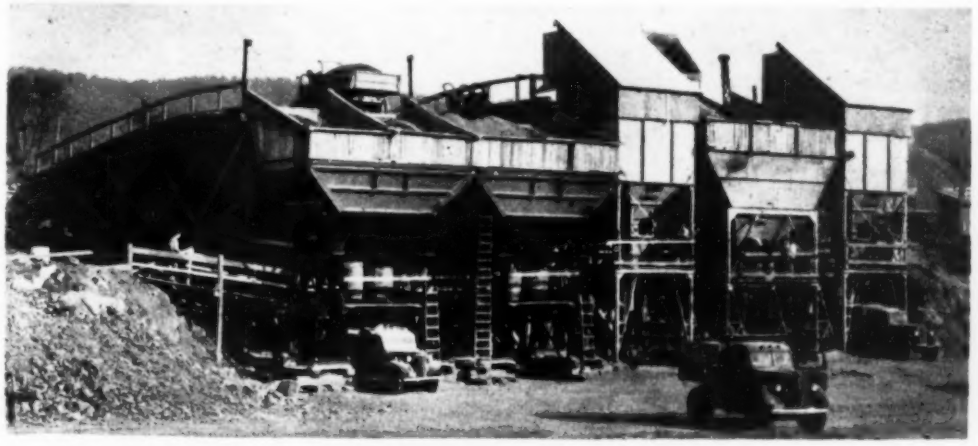
Paving Contracts—Length of paving contracts ranges from a maximum of 10.28 mi., bid in at $886,000, to a minimum of 1.06 mi., valued at $378,000; the latter contract is unusual in that it involves two overhead bridges and an underpass and necessary grading for an interchange—the eleventh and final interchange approved for inclusion in the 160-mi., project. Three longer contracts including structures, grading and drainage, in addition to pavement, were awarded last year; two of these, 5.38 and 6.70 mi. in length, at the eastern

(Continued on page 76)

TWO 12-FT. LANES in separated roadways are paved simultaneously by 34E dual-drum mixer traveling down center of highway on 10¼-mi. contract section of Union Construction Co., Des Moines, Iowa. Outfit includes complete subgrading and finishing equipment for two lanes as also does second outfit consisting of two single-drum mixers working in same manner at other end of this section. Screw-type spreader, single-screed finishing machine, and mechanical longitudinal float operate on each lane. Note drop inlet grating of removable steel rails in right foreground, typical of Turnpike's ditch inlets, designed to permit overrunning by vehicle wheels without accident.



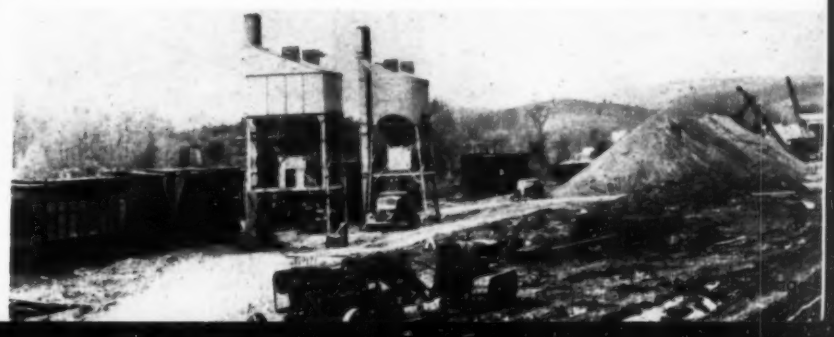
34E DUAL-DRUM PAVER places both 7-in. first layer and 2-in. top layer of reinforced 9-in. slab on contract of W. L. Johnson Construction Co., Hicksville, Ohio. This operation is typical of method employed by majority of contractors using double-drum mixers. On second day's run by 34E machine, contractor is mixing batch slightly smaller than 37.4 cu.ft. permitted while educating truck drivers, accustomed to 29.7-cu.ft. batches, to back on to skip and dump large batch in 38 sec. or less available for this operation in dual-drum mixer cycle.

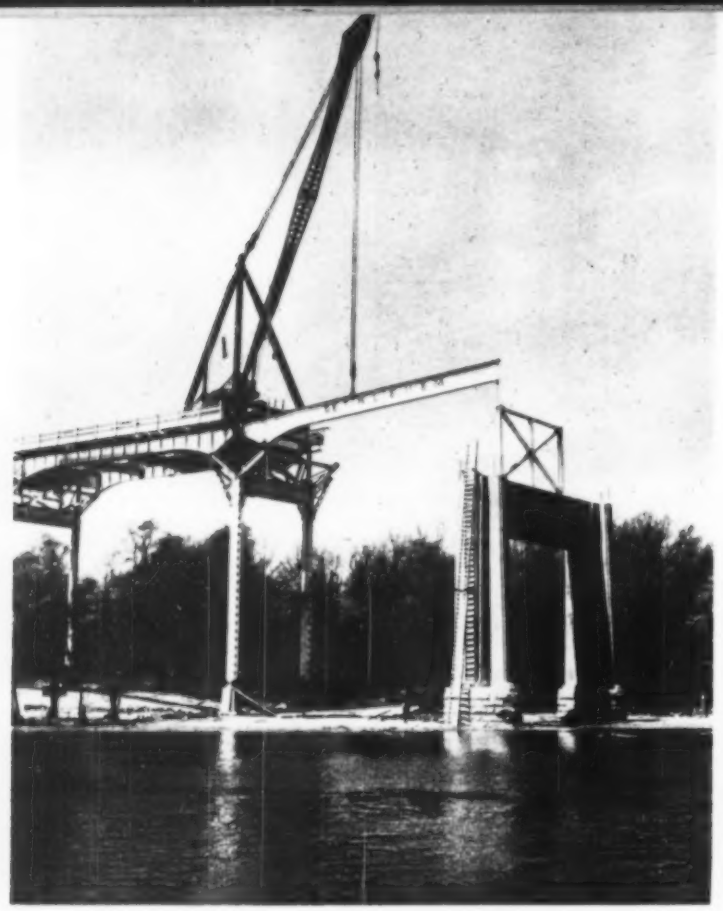


DUPLICATE BATCHERS for cement, sand and two sizes of coarse aggregate serve 34E and 27E pavers from plant of Union Construction Co., which stores thousands of tons of truck-hauled sand and stone at site. Plant is unusual in that it requires backing under all bins.

FILLING 1,000-GAL. TANK TRUCK (left) on Union Construction Co. contract, 3-in. centrifugal pump pulls water from small stream passing through culvert under nearby road. Contractor operates five tank trucks of this capacity to supply one 34E and two 27E pavers.

RAILROAD DELIVERY (below) of sand and cement is possible at roadside batching plant of McNally & Hobeck, Saginaw, Mich., contractors for 6.2-mi. section west of Bedford. Double sets of bins for cement, sand and stone measure batches for 34E dual-drum and 27E follower on this contract. Stone is truck-hauled to stockpiles from quarry crushing plant, as is case on majority of Turnpike paving sections.





DECK TRAVELER with 126-ft. boom sets 95-ft. plate girder in end span of Wichert continuous seven-span group, following erection of 113-ft. 30-ton girders and floor system on intermediate spans. Note rocker bents.

FLOATING TOWER DERRICK of 35-ton capacity sets three-member section weighing 25 tons in truss of arch span crossing east channel. Diagonal member completes Wichert rhomboid panel, pinned at four connections, over channel pier. Top chord pin is about 100 ft. above concrete bent. Pier rests on steel H-piles driven to 132 ft. below low water, while steel piles of falsework bent behind it extend to 122 ft. below water.

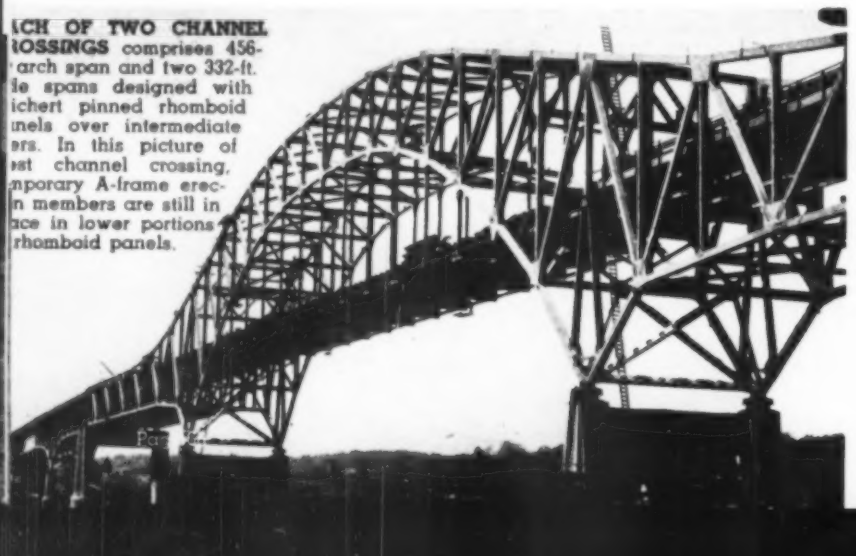
Floating Tower Derrick Erects Arch Spans Over Susquehanna River

STEEL GRID REINFORCEMENT on 46-ft. roadway between two 2½-ft. sidewalks is welded in place with coated electrodes drawing current from portable generating sets.

MOUNTED ON A CATAMARAN made up of two barges, a floating tower derrick with an overall vertical reach exceeding 200 ft. erected steel trusses and lateral bracing of two 456-ft. arch spans crossing the east and west channels of the Susquehanna River at Havre de Grace, Md., where the Bethlehem Steel Co. expects to complete this month the $2,500,000 superstructure of a four-lane toll bridge 7,600 ft. long replacing the existing inadequate double-deck highway bridge on U. S. 40. Arches and side spans 332 ft. long were erected by balanced cantilever methods from the main channel piers with the aid of a single falsework bent under each anchor arm, erection being advanced by progressive stages on the arch and the side span to maintain a reasonably constant reaction of about 300 kips per chord at the falsework bent. The two three-span channel crossings and 27 other spans (both truss and girder type) of the 49-span bridge employ pinned Wichert rhomboid panels over the piers.

To erect the arches, the superstructure contractor set up on the two-barge catamaran a three-legged tower, topped out about 120 ft. above the water, and placed on the tower a 35-ton-capacity stiff-leg derrick carrying an 80-ft. boom equipped with a hammerhead jib about 15 ft. long; the derrick mast was about 50 ft. high. The floating tower derrick, operated by a hoist engine on one of the barges, set field-assembled truss units as indicated by one of the accompanying

(Continued on page 84)



ICH OF TWO CHANNEL OSSINGS comprises 456- arch span and two 332-ft. le spans designed with ichert pinned rhomboid nels over intermediate ers. In this picture of st channel crossing, nporary A-frame erec- n members are still in ace in lower portions rhomboid panels.

ERECTION of 15,000 tons of steel is carried out under direction of G. C. Land, resident engineer, Bethlehem Steel Co.

Present and Accounted For

A PAGE OF PERSONALITIES

On Pennsylvania Turnpike

STARTING CONSTRUCTION of $70,000,000 160-mi. express toll highway less than 21 months ago, WALTER A. JONES, chairman, Pennsylvania Turnpike Commission, turns up first shovelful of earth Oct. 27, 1938. To left of Mr. Jones are SAMUEL W. MARSHALL, chief engineer, holding cigarette, and ROGER B. STONE, construction engineer, holding white prints. Fourth man is G. DOUGLAS ANDREWS, former associate director of Region No. 1, PWA

"TO HIM GOES CREDIT," say other Turnpike engineers, "for completing seven tunnels on schedule"; but RICHARD M. MERRIMAN, chief tunnel engineer, asserts that credit must be shared by contractors and all field personnel.

AT EXTREME EASTERN END of Turnpike, H. G. DIXON, superintendent, manages 5.4-mi. $1,200,000 job for Johnson, Drake & Piper, Inc., Freeport, L. I., N. Y.

CAPABLE ENGINEERING by skilled, hard-working personnel enables Turnpike Commission to build 160-mi. highway to high standards in record time. Representative members of engineering field force are: (left to right) TED BABER, resident engineer; J. D. COOPER, resident engineer; and J. P. McINNIS, assistant district construction engineer, Shippensburg district.

NIGHT WALKER in Guthrie-Marsch-Peterson's Allegheny tunnel, V. F. ROBERTSON carries share of responsibility for rapid progress in Turnpike's first completed mountain bore.

PAVING OPERATIONS of McNally & Hobeck are directed by ROY HORNING (left), general superintendent, and R. A. WILLIS, construction superintendent, on 6.2-mi. contract.

FRIENDLY COOPERATION and mutual respect mark relations of contractors and engineers on Turnpike, as signified by teamwork between FRED I. ROWE (left), member of W. L. Johnson Construction Co., Hicksville, Ohio, and D. P. LINGAFELT, resident engineer.

SOUTH DAKOTA CONTRACTOR. States Engineering Co., of Rapid City, holder of two paving contracts, has GEORGE A. COFFEY (left) on scene as general superintendent, with ED. D. PLUMMER as superintendent on one job.

"SHE KNOWS COSTS." assert associated supervisors regarding Miss MARGARET McNALLY, daughter of Thomas McNally and active representative on paving job of McNally & Hobeck, contractors, Saginaw, Mich.

BATTING IT OUT BY NIGHT as well as by day, NATHAN D. BLOOMER steers John F. Bloomer's three-shift paving job to daily outputs as great as 7,880 sq.yd.

RUNNING THREE-SHIFT PAVING JOB for W. L. Johnson Construction Co., L. M. DEARDORF, superintendent, employs number of ingenious devices to smooth paving progress.

CONSTRUCTION EQUIPMENT NEWS

Review of Construction Machinery and Materials for JULY, 1940

LEANING WHEEL GRADER TIRE is fashioned without definite shoulder and rides naturally at any angle without undue wear or strain. Usual tread surface protected by heavy, deep, grooved tread to resist side-slip for operations in ditches or on road shoulders. "Ankles" or side-walls of tires have radial cleats said to prevent them from slipping and to keep them rotating even when wheels are working at angle in muddy going. Designed for front wheels of power graders, all wheels of pull-type graders. Available in three sizes, 6.50x20, 7.50x24 and 8.25x24 in. — **B. F. Goodrich Co., Akron, Ohio.**

★ ★ ★

TWIN CABLE SCOOPS said to combine efficiency, speed and economy under unusual operating conditions, may be had in six models with rated capacities of 6, 8, 10, 12, 16 and 24 cu.yd. for tractors

respectively of 40-50, 60-75, 65-85, 75-90, 90-120 hp. Tilting floor discharge claimed to assure clean, fast and positive elimination of load. Turning radius, 23 to 30 ft. Simplified controls mounted on rear of tractor within easy reach of operator take care of five operations—digging, hauling, dumping, spreading and finishing. Front apron has high arched side arms hinged well up inside bowl. Minimum dirt resistance said to assure easy closing action. Front gate actuated by same cable that controls tilting floor. All cables and sheaves above dirt line of load in bowl. Front gate opening ranges from 44 to 54 in., depending on model. Scoops operate with all makes of crawler tractors. — **The Heil Co., 3000 W. Montana St., Milwaukee, Wis.**

Costs Cut

BY ROEBLING "BLUE CENTER" WIRE ROPE

USERS of all kinds of earth moving equipment have found that the use of Roebling "Blue Center" Wire Rope assures minimum wire rope cost. The above user is a typical example.

The *Ace* of all Roebling Wire Ropes—"Blue Center"—has been specially developed by Roebling, through years of research, to provide the maximum of durability, safety, and economy in rope service. It is made of famous Roebling acid open-hearth steel—which provides maximum resistance against abrasion, fatigue, and sudden shocks.

Specify Roebling "Blue Center" Wire Rope when you re-rig your equipment. We are confident that your experience will parallel that of other contractors, who have proved to their complete satisfaction that "Blue Center" assures lowest average rope operating cost.

JOHN A. ROEBLING'S SONS COMPANY, TRENTON, N. J.

Branches in Principal Cities

ROEBLING

WIRE ROPE

STANDARD OR PREFORMED

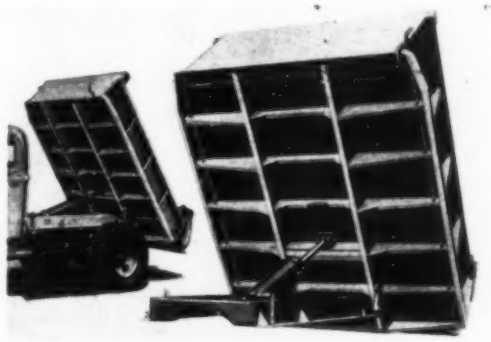
ROEBLING "BLUE CENTER"... *The Finest of all Roebling Wire Ropes!*

HIGH POWERED 10-TON DIESEL LOCOMOTIVE, built to height of 56 in. to permit passage under low clearance, incorporates General Motors two-stroke cycle diesel engine developing full 120 hp. and furnishing 12 hp. per ton of locomotive weight, said to be an exceptional ratio. Applied through range

of four speeds in both forward and reverse, this flexible power is said to make possible speed up to 15 m.p.h., negotiation of heavy loads on grades on higher gears and consequent high daily tonnage. Performance claimed to be improved further by four-wheel drive, steel tires which increase traction more than 25 per cent, dual journal spring suspension which permits negotiation of rough, uneven tracks or sharp curves at relatively high speeds and Timken tapered roller bearings in all wheel journals.—**Brookville Locomotive Co., Brookville, Pa.**

★ ★ ★

TRUSSED UNDERSTRUCTURE for dump truck bodies provides direct full length support to floor by integral longitudinals in combination with trussed-type cross members resulting in a more rigid body. Sides and floor sections which form body longitudinals are welded integrally. This construction is



said to give maximum strength to floor in resisting shocks and sudden load impacts. Also provides greater reinforcement in center of floor where abuse is most severe. Available with all types of Gar Wood truck bodies which are equipped with direct-lift underbody hydraulic hoists and patented cam and roller hoists.—**Hoist & Body Division, Gar Wood Industries, Inc., Detroit, Mich.**

★ ★ ★

SINGLE BUCKET SCRAPER, 25.8 cu. yd. struck capacity and 33 cu. yd. heaped, designed for pusher loading, is constructed with higher sides and larger apron, and has longer and steeper cutting blade base, facilitating easy and fast loading and causing material to boil in—to flow back into bowl and forward into apron. Cable controlled fractional inch cutting, positive ejection and measured spreading said to be attained through instant response of

power control unit. Additional feature: instead of placing lifting sheave on apron where it would be covered by earth, cable was dead ended on apron and apron sheaves were placed on top of spring pipe where they travel back and forth in a slide, said entirely to eliminate abrasive cable wear. Easier passage of sticky materials is permitted by arched A-frame which also is said to add to strength of scraper. Flotation and compaction provided and resistance minimized by use of four 24x32-in. tires, 80 in. high. Gooseneck yoke assures greater tire clearance.—**R. G. Le Tourneau, Inc., Peoria, Ill.**

6-CYLINDER DIESEL POWER UNIT which develops 1,400 r.p.m. is started on gasoline, and after minute or less, shifts to full Diesel operation. A standard 12-v. electric starting system is available, if desired. Is of rugged, compact construction and said to be of ample weight (approximately 3,875 lb. less fuel, oil and water) and reserve strength for heavy-

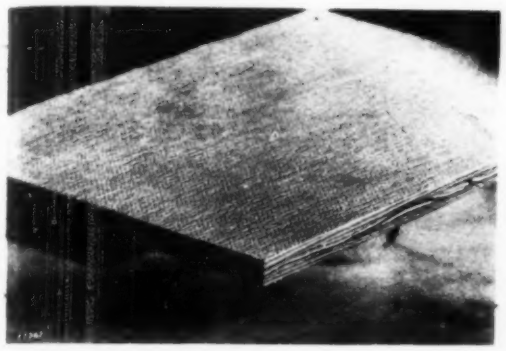
duty service. Individually replaceable, specially heat-treated cylinders have 4¾x6½-in. bore and stroke. Piston displacement, 691 cu.in.; maximum torque, 430 lb./ft. at 800 r.p.m. Seven-bearing crankshaft is heat-treated alloy-steel drop forging, Tocco hardened. Replaceable bearings diamond bored to assure accurate size and shape. Thermostatically controlled cooling system; full pressure lubrication through drilled passages. Heavy-duty over-center type clutch, 17 in. in diameter with 312 sq.in. of friction facing area, has torque capacity of 1,488 lb./ft. and locks when engaged or disengaged. Overall length of power unit 95⅞ in.; width 35⅞ in.; height, 61 7/16 in.—**International Harvester Co., 180 N. Michigan Ave., Chicago, Ill.**

★ ★ ★

PACKAGE STEEL WINDOW, in eight standard sizes, has been brought out by makers of Fenestra steel casements to serve low-priced home market. Completely prefabricated window unit is delivered to job equipped with glass, cased with California redwood, fitted with bronze-finish operating hardware and with interior wood trim ready to be nailed in place. Eliminates necessity of having windows refitted or rehung. Advantages: (1) Steel construction is assurance against warping, shrinking, swelling or sticking and assures easy opening and closing; (2) air-deflector ventilator admits air from

several directions rather than one; (3) precision fitting at factory makes for weather tightness; (4) bonderizing for rust protection also acts as bond for finishing paint coat, reducing repainting costs. Provision made for installing prefabricated screens and storm sash. May be placed by one man in 5 min., according to manufacturers. Redwood casing fits ordinary wood stud wall construction allowing ¾ in. on outside for sheathing and ¾ in. on inside for plaster or insulating board and permitting its use in brick veneer or in frame houses with shingle, clapboard or other type of siding.—**Detroit Steel Products Co., Detroit, Mich.**

COMPOSITE PLYWOOD PANELS in room sizes up to 8x20 ft. and faced with fabric are said not to require making of joints and to provide base for easy and quick decoration on which checking and cracking are minimized. Jumbo Speedwall, as it is called, is made up of standard grade, water resistant Douglas



fir plywood panels hot press "welded" together with synthetic resin glues. Surfaces to be decorated are sealed and "dressed" with strong woven fabric applied by special adhesive which provides fire resis-

tance and moisture barrier. Applied to standard construction studding. Doors, windows and other openings cut on job. Recommended for use in repair of old broken plaster walls, new room additions, renovating old interiors, building partitions, attics and basement rooms.—**The Speedwall Co., 5035 First Ave., S., Seattle, Wash.**

★ ★ ★

EXCAVATING SCRAPER. 9½- and 12½-cu.yd. capacities, known as "Wheeler," travels from loading point to fill and return at speeds as high as 20 m.p.h. behind Koehring pneumatic-tired gasoline or diesel powered tractor to which it is attached below and ahead of drive axle by means of "non-raring" hitch. Wheeler may be loaded in 30 sec., according to its manufacturers, because of application of power behind and ahead of cutting blade, after which pusher tractor is free to load other units.

Faster dumping accomplished at travel speeds permitted by grade by precision air control of front apron which is raised or lowered as needed. Rear apron tips forward pushing load to point of ejection. Wheeler body rests flat on ground for loading, depth of cut being controlled by operator manipulating independently operated cable, and can be raised to provide 21-in. clearance under cutting edge for free dumping. As pull on tractor increases, grade grip of front tractor wheels becomes more positive. Free universal action is provided at upper end of hitch yoke, allowing Wheeler body and tongue to move in any direction without twisting strains.—**Koehring Co., 3026 W. Concordia Ave., Milwaukee, Wis.**

1¾-YD. EXCAVATOR is available with complete line of interchangeable boom equipment for conversion to shovel, dragline, crane, clamshell and backdigger. Turntable built to Thew center-drive design. Outstanding features named by makers: Simplicity of construction and ability either to concentrate power entirely on one operation or to spread it over two or three simultaneous and synchronized operations. Unit may be powered by 6-cylinder Waukesha-Hesselman oil, full diesel or 6-cylinder gasoline engines or electric motor. Crawler base, center chain drive, is 14 ft. 1 in. long and 10 ft. 10 in. wide, equipped with 28-in. treads, with 34-in. treads optional. Crawler has two travel speeds: high, 1½ m.p.h.; low, ¾ m.p.h. Other features: completely inclosed propelling and steering mechanism; pressure lubrication for all shaft bearings; ratchet and double pawl providing travel and safety lock; automatic crowd brake holding stick extended against back drift when crowd lever is in neutral; power dipper trip. All-welded, all-steel design shovel boom, 24 ft. 8 in., with 18-ft. dipper stick. Two stripping booms available: one 25-ft. with 25-ft. stick and 1½-yd. dipper; other 30 ft. 6 in., with 25-ft. stick and 1¼-yd. dipper. — **The Thew Shovel Co., Lorain, Ohio.**

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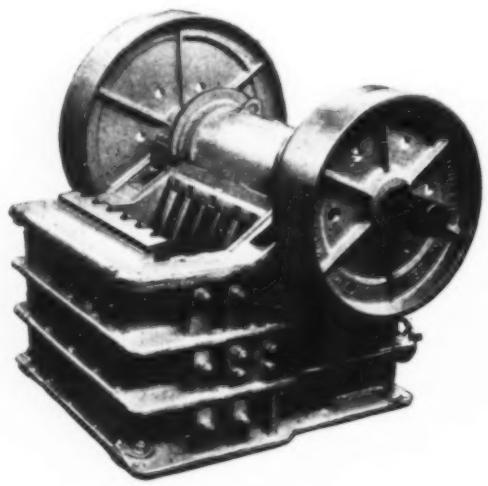
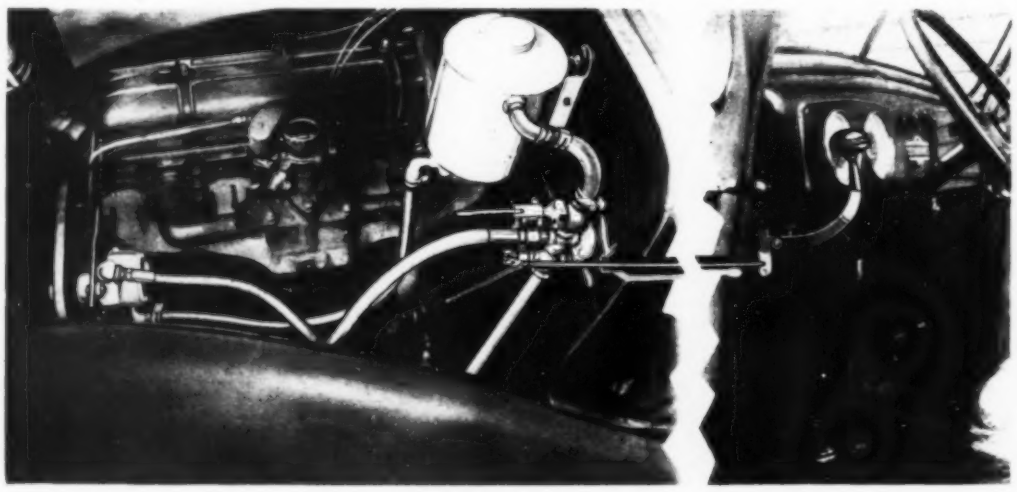


NEW STYLE JAW PLATES designed to eliminate slab shaped rocks from crusher product are now available for use on Pioneer 2036 Jaw crusher. Plate has wavy rather than corrugated shape. Waves are spaced 6 in. from peak to peak, the peak of one jaw fitting into valley of opposite one. Effect of this type of jaw plate is to subject slab-type rock to true breaking strain, rather than to squeezing pressure of other types of jaws, thus eliminating tendency of rock to slab. Another advantage claimed for wavy-shaped jaws is reduction in wear, assuring longer working life.—**Pioneer Engineering Works, Inc., 1515 Central Ave., Minneapolis, Minn.**

★ ★ ★

HIGH-PRESSURE POWER PUMP, called the "Hy-Rocket," for operation and control of hydraulic snow plows, truck maintainers and other road machinery is said to assure positive control of heavy, hard-to-handle equipment by flip of finger. Features: (1) Delivers 1,000 lb. of pressure per square inch, supplying ample power, pressure and capacity for operation of specified hydraulic equipment; (2) quick controlled action, because acceleration of truck engine governs pump output; (3) fan-belt driven—because power is obtained at source, only one-third horsepower is required to operate; (4) hood covering assures protection from weather; (5) one-lever cab control; (6) self-lubricating; (7) compact—easy to install on any truck.—**Monarch Road Machinery Co., 327-329 Front Ave., N. W., Grand Rapids, Mich.**



Pennsylvania Turnpike

(Continued from page 65)

end of the turnpike, exceed $1,200,000 and $1,100,000 in value, respectively. The average of all 29 paving contracts is about 5.3 mi. in length and about $520,000 in value.

A trip over the Turnpike during the week ending May 25 disclosed a surprising uniformity in the subgrading, concreting and finishing equipment employed by the contractors. In general, the equipment duplicated closely the plant used on the Turnpike's first paving contract, described in *Construction Methods, January, 1940, pages 52-55, 108-110.* This job, incidentally, was apparently destined to rank as one of the two or three outstanding paving operations of the entire project. With its overall efficiency of 89 per cent and an average progress of 228 lin.ft. of 12-ft. lane for each mixer-operating hour during 77 working days last fall, the job may fairly be regarded as the pace-setter for the entire Turnpike in rate of progress, in methods and in equipment.

Within the framework of equipment standardization, the contractors displayed originality in working out individual paving procedures and in arranging various combinations of machine units. Partly because of a reported reluctance on the part of the Turnpike Commission to approve plans for paving a full roadway width of 24 ft. instead of a single lane, 24-ft. pavement was placed by only two contractors, John F. Bloomer, of Appleton, Wis., and William D. Vogel, of Indianapolis. All other contractors operating during the week ended May 25 were placing concrete in single 12-ft. lanes, although the Union Construction Co., Des Moines, Iowa (holder of a $978,000 contract for 10.23 mi.), varied this procedure by paving two separated lanes in opposite roadways from a paving outfit traveling down the center of the highway. This method was employed by each of two mixing outfits on the job.

Accompanying photographs give a fairly complete picture of the various types of plant and paving methods on 130 mi. of route from the eastern terminus to Somerset. Rain on the last day of the trip made it impossible for contractors to work on the eight paving section from Somerset to the western terminus, and no photographs of actual operations could be made, therefore, at the time of the inspection. With the exception of Vogel's 24-ft. paving, on which he was operating a 27E dual-drum and a 27E single-drum boom-to-boom, and the use of truck-hauled batch boxes to serve a 34E dual-drum and a 27E single-drum operated one behind the other by the Tri-State Engineering Co., Washington, Pa., these contract sections exhibited no notable variation from standard methods.

Standing out among the mass of familiar equipment on the Turnpike was one innovation particularly worthy of note, the new Blaw-Knox concrete spreader, which utilizes a novel and effective principle for the spreading operation. Walker Bros., Chambersburg, Pa., the notably successful contractors of last fall, made one important change in their equipment to complete a few required omissions in their first 10.28-mi. contract and pave two other contract sections at another location on the Turnpike, substituting one of the new spreaders for the former method. In the opinion of their engineer, C. S. Monroe, a principal advantage of the new spreader is that it speeds finishing by eliminating undesirable segregation which brings coarse aggregate to the top surface of the slab. The new spreader has ample power, weight and speed to take care of the maximum output of a 34E dual-drum paver, yet its method of operation is so designed that the machine causes no observable sway or settlement of the forms.

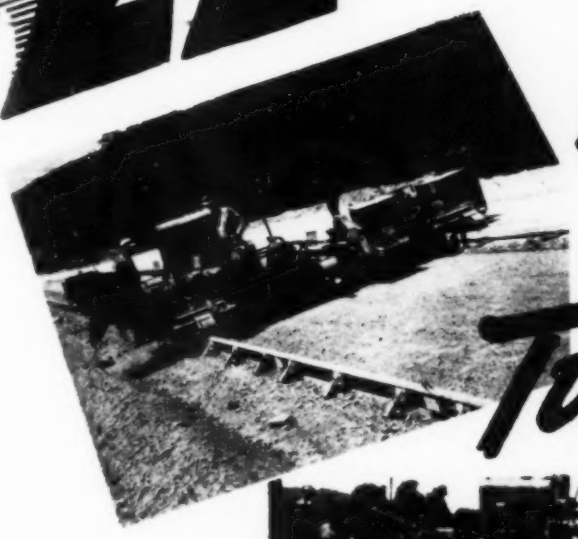
PAVING 11½-FT. LANE for 23-ft. tunnel roadway, Guthrie-Marsch-Peterson Co. uses single-screed finishing machine equipped with adjustable-strikeoff plate for leveling first and second courses of 10-in. reinforced slab specified for tunnel pavement.

Basically, the chief feature of the new machine is a pivoted spreading blade which operates transversely, back and forth across the roadway, in front of the strikeoff. Looked at from above, the spreading blade is T-shaped, and concrete is spread by two arms of the T as the blade travels in each direction across the concrete. At the end of a stroke, next to the edge form, the blade automatically turns through a part circle, spreading concrete against the form before starting its return trip to the opposite side of the roadway. The troweling action of the reciprocating blade spreads practically all of the concrete deposited between the forms and leaves little to be bulldozed by the strikeoff, thus greatly reducing the tractive effort required to propel the machine.

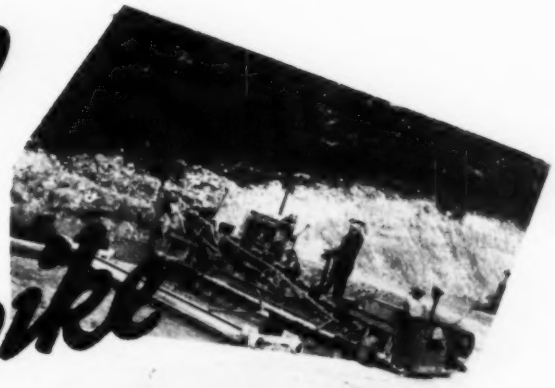
As built for 12-ft. construction on sev-

(Continued on page 78)

22 R.B. FINEGRADERS



Keep the Turnpike



On the Pay Line!

Top Left: **One of the four 12 foot R.B. Finegraders that Union Construction Company has kept moving on the Turnpike!**

•

Top Right: **Shullo's R.B. Finegrader equipped with rubber tired wheels for riding on the Turnpike slab!**

•

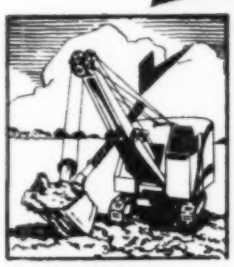
Center: **A grade that leaves nothing to be desired on Wm. Vogle's Turnpike job with a 24 foot R.B. Finegrader.**

UP AND DOWN the length of Pennsylvania's famous Turnpike you'll see 22 R. B. Finegraders on 19 different jobs hewing the grade right to specifications — building a finegrade that's clean and true and well compacted despite the rocky soil conditions! And they're moving fast — John F. Bloomer's 24 foot R. B. has cut 2100 feet of grade in 20 hours — others are setting the pace an easy 1000 feet out ahead of the pavers!

If anything ever proved the advantages and superiority of R. B. Power Finegrading, it's the Turnpike, where every ounce of pressure is being exerted to button down jobs and make up time lost by days and days of downpour — where many of the nation's leading paving contractors have depended on R. B. Finegraders to keep the job moving, to keep costs down, to reduce loss of yield and build a finegrade that's "RIGHT ON THE PAYLINE".

Take a tip from the Turnpike. Plan now to put an R. B. rinegrader on YOUR next job. Write for descriptive literature TODAY! BUCKEYE TRACTION DITCHER COMPANY, Findlay, Ohio.

BUILT BY Buckeye



Convertible Shovels....

Trenchers . . . .

Tractor Equipment. . .

R. B. Finegraders. . .

Road Wideners. . .

Spreaders . . .

(Continued from page 76)

eral Turnpike contracts, the spreader has three speeds forward and reverse, 11, 20, and 122 f.p.m. An automatic unit-type transmission both propels the machine and operates the spreading blade, but the two motions are independently controlled by the operator to permit spreading with the blade while the machine is standing still on the forms. On the Walker Bros. job, the operator kept the machine in second gear when spreading concrete and used high gear only on run backs and when completing spreading. Based upon observations of the machine operating in second gear, it may be roughly estimated that the spreading blade made a cross trip one way between the forms for each foot of machine advance. Spreading blade and strikeoffs were readily adjusted by means of a control lever to spread concrete 2 in. below the top of the forms, as a bed for the reinforcing mesh, or to strike off the top course to final grade.

Paver Operations

Transverse expansion joints were installed in Turnpike slab at intervals of 76½ ft., and five sheets of reinforcing mats or mesh were placed 2 in. below the surface of the concrete in each 76½-ft. block. Concrete contained two separated sizes of coarse aggregate, graded from ¼ in. to 1 in. and from 1 in. to 2½ in. The cement factor was about 1.56 bbl. per cubic yard. Water was restricted by the specifications to 5½ gal. per sack of cement, but the materials and inspection engineer was ready to make adjustments where necessary to bring the concrete within a slump range of ½ to 1½ in.; the normal concrete slump on the Turnpike was about 1¼ in. Concrete was vibrated internally at the transverse expansion joints.

Of the 21 dual-drum pavers seen during the inspection trip, 13 were working as individual units, placing both layers of concrete, and eight were teamed up with 27E single-drum followers which placed all the 2-in. concrete on top of the reinforcing steel and, on most jobs, moved up to fill omitted gaps in the 7-in. layer, this extra concrete placement being required in order to utilize the full production capacity of the 27E's. The teamed dual-drum and single-drum pavers worked boom-to-boom. Mixers were allowed a 10 per cent overload, equal to a 37.4-cu.ft. batch for the 34E's and a 29.7-cu.ft. batch for the 27E's.

Of the remaining 27E single-drum pavers in operation at that time, two were working individually, and the other four were either running or preparing to run in pairs, boom-to-boom, although one contractor was planning to turn the second single-drum paver of a pair to travel in the same manner as the first, with the boom at the rear, in order to save additional turning of batch trucks and some travel distance for the second paver. Among the eighteen 34E dual-drum pavers were 12 Koehring and 6 Rex units; the three 27E dual-drums were Ransomes. The fourteen 27E single-drum paving mixers included five Rex, four Koehring, three Ransome, and two Foote.

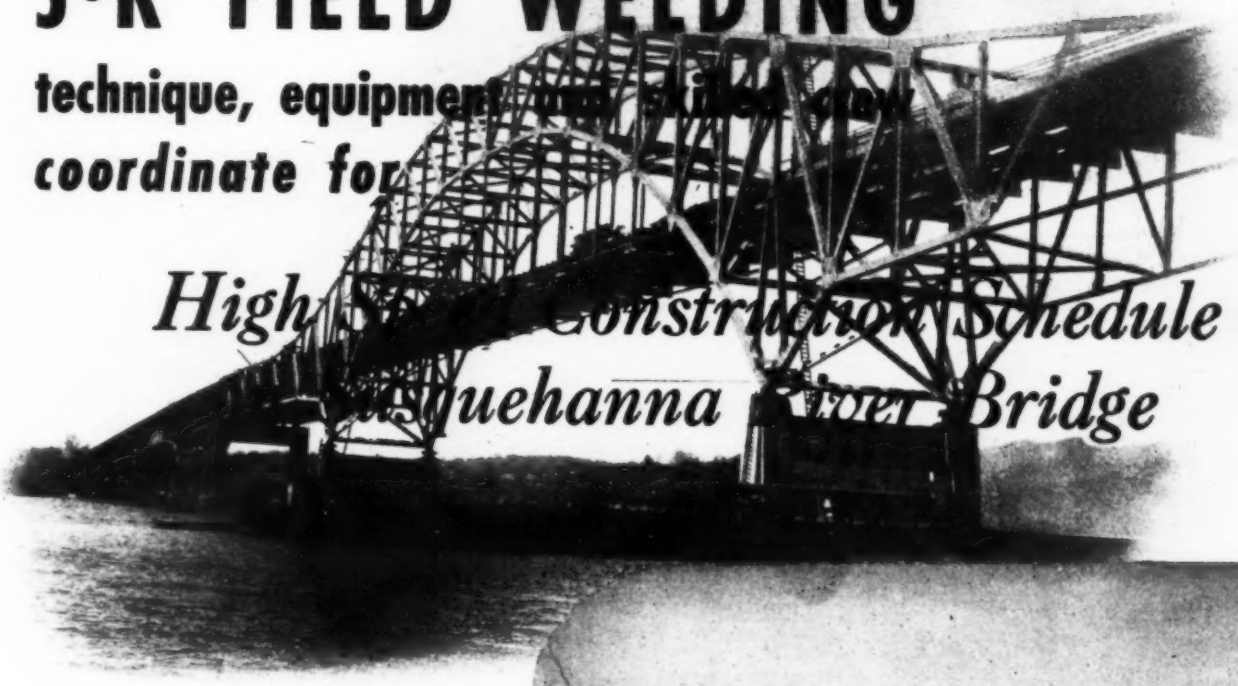
According to the specifications, pavers

(Continued on page 80)

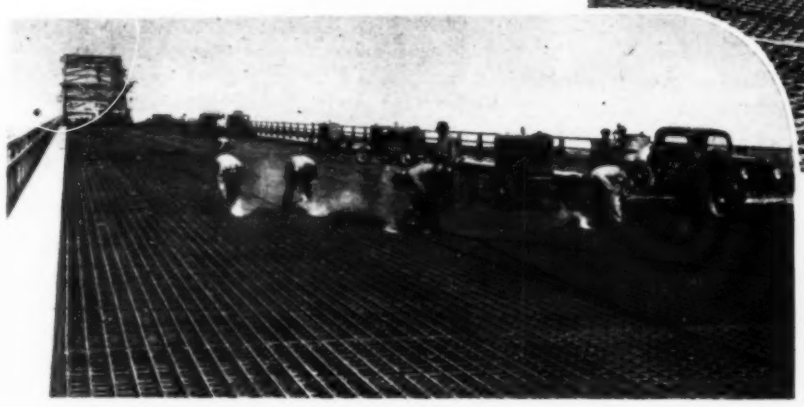
J·K FIELD WELDING

technique, equipment and skilled crew coordinate for

High Speed Construction Schedule Susquehanna River Bridge



DECK WELDING FOLLOWS CLOSE ON HEELS . . . OF STEEL ERECTION . . .
. . . Completion Speeded



THIS IS THE SECOND of a series of pages describing outstanding examples of how J-K Welding cuts costs and speeds construction.

Field welding technique and skilled crew of J. K. Welding Company Inc. serve Bethlehem Steel Company, superstructure contractor, in welding 345,000 sq. ft. of steel grid decking on the 46 ft. roadway of Susquehanna River bridge at Havre de Grace, Md., being erected by the Maryland State Roads Commission with the J. E. Greiner Company, Baltimore, as consulting engineers on design and construction. Work is rushed on a high-speed schedule to meet an early completion date, and the facilities of the J. K. Welding Company keep deck welding close behind steel erection. As a result of this coordination, concrete roadway paving, placed on the welded steel grid, is able to follow closely behind steel erection, and the roadway pavement thus will be ready for traffic soon after the final steel members are riveted in place.

Length of the bridge is 7,600 feet, including two 456-ft. main spans, flanked by 325-ft. side spans, over the east and west channels of the river. Transverse roadway beams supporting the steel grid are spaced 4 ft. 11 11/16 in., center to center. Reliance steel grid units with bottom steel pans (to hold the concrete) shop-welded in place are delivered to the bridge in prefabricated sections 4½ ft. wide, except the units for the two edges of the roadway, which are somewhat narrower. Lengths of the sections ordinarily range from about 20 to 40 ft. to permit ready handling and to fit into the distances between expansion joints on the bridge. The Bethlehem Steel Company places the grid in position on the roadway.

Steel grid units are welded to each transverse roadway beam, and sections across the width of the roadway are joined to one another by welding transverse bottom rods and top rods of the grid.

In addition to the welding of the grid, J. K. is welding sidewalk members at the two edges of the roadway to both ends of each transverse roadway beam.

Above photographs show a general view of west channel crossing and J. K. welding operators and welding machines at work on the steel grid deck reinforcement.

OTHER J. K. JOBS NOW UNDER CONTRACT:

Housatonic River Bridge, Conn. Welding I-Beam-Lok steel grating for the AMERICAN BRIDGE COMPANY.

Raritan River (Thomas A. Edison Memorial) Bridge, Perth Amboy, N. J. Welding Bethlehem bar trusses for JOHN G. ENGLISH, Inc., and JOSEPH NESTO & COMPANY.

Pit River Bridge, Calif. Welding steel reinforcing bars for piers in conjunction with SOULE STEEL COMPANY for UNION PAVING COMPANY.

J·K WELDING CO., INC.
43-19 37th Street
LONG ISLAND CITY, NEW YORK

IN TUNNEL as well as on open highway, fine grade is rolled by smooth steel rollers, as indicated by this unit ironing grade in Allegheny Mountain tunnel, where Guthrie-Marsch-Peterson Co., Chicago, Ill., is first of tunnel contractors to start roadway paving in any of seven bores.

(Continued from page 78)

could be operated on the pavement after the slab had been in place not less than twice the time required to obtain a 550-lb. beam break. The specified flexural strength normally was obtained in 4 days, permitting paver operation in 8 days. Pavers were required to travel on 2-in. wooden mats or ½-in. minimum-thickness fiber belting laid on the slab; the contractors preferred to use belting.

Of the 25 paving outfits observed, 23 used concrete spreaders. Four of the spreaders were new Blaw-Knox units; but the vast majority of the spreaders were the Jaeger reversible screw type, of which 22 were at work on the Turnpike. Behind each dual-drum paver operating singly, one spreader was sufficient in all cases, although one contractor used no spreader behind his 34E dual-drum. To spread concrete deposited by a dual-drum mixer and a single-drum mixer, operated as a team, six contractors employed a single spreader (of which one worked on 7-in. layer only), one contractor used two spreaders, and the eighth contractor in this group struck off concrete without any special spreading equipment. It is essential to point out that the two contractors working without spreaders were placing concrete to a full roadway width of 24 ft.; all outfits paving 12-ft. lanes utilized mechanical spreaders.

Finishing Machines—On 24-ft. paving, each of the two contractors operated two Heltzel single-screed finishing machines, the first being equipped with an adjustable strikeoff plate to level the 7-in. lower course for the reinforcing steel. Among the other outfits, all of which spread concrete in 12-ft. lanes mechanically, sixteen used two finishing machines (1) behind dual-drum pavers, (2) behind combinations of dual drums and single-drums and (3) behind pairs of single-drums. Five operators of dual-drum outfits employed only one finishing machine for each of the large capacity mixers. Of 41 finishing machines observed on the Turnpike, 13 were Jaeger-Lakewoods, 6 were old Lakewoods, 9 were Heltzels, 4 were Blaw-Knox gas-electric units, 7 were Blaw-Knox gasoline machines—many of them of the new type with synchronized screeding action, and two were old Ords.

Curing Concrete Slab—An almost unanimous preference for 24-hr. curing under wet burlap and 48-hr. curing under two-ply kraft paper, water-proofed and cemented together by an internal, reinforced layer of asphalt, was exhibited by the contractors on the project. Sisalkraft paper was almost universally employed. Two contractors used burlap mats, filled with cotton or jute, for the full 72-hr. curing. To keep up with the production of a 34E dual-drum paver, laying 12-ft. lane, a job utilized about 9,000 lin.ft. of Sisalkraft in sheets 70-ft. long.

Water Supply—Twelve contractors used tank trucks instead of pipelines to supply water to 15 outfits for mixing and curing, while the remaining seven contractors then operating used pumps and pipelines to serve ten outfits, Gorman-Rupp triplex pumps and 3-in. pipe apparently being the most favored. On several of the latter jobs, tank trucks were used for sprinkling burlap.

Batch Hauling—A number of contractors operated their own fleets of batch trucks, but the common practice was to have batch-hauling done by a sub-contractor who hired local trucks as needed to supplement his own equipment. Two-batch trucks were the most popular size, with many three-batch hauling units in use. The largest single fleet noted on the Turnpike consisted of 28 two-batch and three-batch trucks hauling 14 mi. one way to a pair of 27E single-drum pavers.

Batch Plants—Of nineteen plants which came under observation during the course of the trip, eight were set up on railroad sidings and were equipped (1) with cement-unloading plants and (2) with cranes to handle sand and coarse aggregate. Several other plants, which were not seen, also occupied track-side locations. Among twelve plants observed on or near the highway, nine were erected at hillside locations for truck dumping of aggregates and, generally, of cement as well into overhead bins. At the remaining three plants

TWO-WHEELED PNEUMATIC-TIRED PORTABLE COMPRESSORS of 110-c.f.m. capacity are popular for driving form pins with pneumatic hammers, as used by this crew on 7½-mi. contract of Andrews & Andrews, Inc., New York City. This compressor operates two special pin hammers.

(Continued on page 82)

POWER
NO OTHER TRUCK CAN MATCH

General Motors Trucks *outpull, outperform, outsave* all others, in every capacity range from ½ ton to 15 tons! Their great *Super-Duty* Engines, fitted with revolutionary Step-Head pistons, produce power results heretofore unachieved. With so much more pulling power, they are able to work faster, doing many more ton-miles of hauling per hour. Yet the driving job is *easier* . . . Besides the advantage of extra-flexible power, GMC alone in the medium and heavy-duty fields provides *Ball-Bearing* Friction-Free Steering that reduces steering effort as much as 57%. Finally, the record-high *gas savings* every GMC model can claim, assures lower operating cost and considerably greater net earning power from every dollar invested! Yes, GMC is "the truck of value."

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***NEW* 6-WHEELERS**

For hauling as much as 50% more payload within legal wheel-load limits. Both dual-drive and trailing types

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Exclusive GMC 2-Cycle principle gives you smoother power, lighter weight, smaller size

ONLY GMC OFFERS ALL THIS *EXTRA VALUE*

SUPER-DUTY Valve-in-Head Engines • RIDER-EASE Cabs • QUICK-VISION Instrument Panels FRICTION-FREE Steering • SEALED-BEAM Headlamps • SYNCRO-MESH Transmissions (in heavy-duty models)

THE TRUCK OF VALUE

GMC TRUCKS
GASOLINE DIESEL

(Continued from page 80)

near the highway, bins were charged by cranes.

Where two sizes of batches were being sent out from the same plant, several contractors erected duplicate bins to batch cement, sand and coarse aggregates. Other contractors in the same situation operated one set of bins equipped with double-scale batchers. Of the total of nineteen batch plants observed, eleven were straight drive-through, one required backing under all bins, and seven were a combination of drive-through and back-under. Cement bins generally had a capacity of about 350 bbl.; the most popular size aggregate bin was a three-compartment unit holding a total of 150 tons.

At plants at which materials were being delivered by truck, the contractors maintained a normal storage of 10,000 to 30,000

MECHANICAL FORM TAMPER (above) rams earth under bottom flange of steel forms for Andrews & Andrews, Inc. Oil spray on machine applies oil to inside of form **(below)** as operator moves tamper forward. Note stone backfill (over perforated pipe underdrain) crossing subgrade in direction of drop inlet, covered by grating in foreground, in center ditch of highway located at this point in hillside cut and fill.

tons of sand and coarse aggregate. On all parts of the Turnpike except 32 mi. at the west end, the required coarse aggregate was crushed stone. Even on this part of the project, the majority of the contractors used crushed stone instead of washed gravel. Where cranes were operated, the 1½-yd. size was most popular. Bucket

(Continued on page 84)

(Continued from page 82)

loaders handled materials out of stockpiles into shuttle trucks at several plants.

Forms and Fine Grade—Almost without exception, the contractors employed formgrading machines to cut the form trenches, pneumatic hammers to drive the form pins, and mechanical tampers to compact the soil under the bottom flanges of the steel forms. During the course of the trip, there were observed on the Turnpike fif-

FORMGRADERS excavate form trenches to line and grade for practically all paving outfits operating on Pennsylvania Turnpike.

teen Cleveland formgraders and nine Carr formgraders; others in operation at that time were not seen. Portable two-wheel pneumatic-tired compressor units of 110-c.f.m. capacity appeared to be the popular choice of power units for the pneumatic hammers driving form pins. Some outfits operated special pin-driving hammers, while others utilized converted jackhammers and paving breakers. Among the steel forms in use, Blaw-Knox, Heltzel, Lakewood, Truscon and Metaform were represented by thousands of feet. Probably the largest quantity of forms was on the contract of the Union Construction Co., building two 12-ft. lanes with each of two paving outfits; this contractor had 30,000 lin.ft. of new Blaw-Knox forms. Practically every outfit used a Jaeger form tamper.

Each fine-grade crew operated a subgrading machine on the steel forms. During the week ending May 25, contractors had on the job 22 Buckeye RB subgraders, of the type which propels itself forward by means of two winch-operated steel hauling cables, and six Flynn subgrading machines which are self-propelled by crawler traction on the steel road forms.

Smooth steel rollers of large and small size operated ahead of and behind the fine-grading machines. Rocky subgrade in some places, particularly through the central area of the Turnpike, caused delays in fine grading and form setting, occasionally requiring preliminary use of rooters and scrapers. The rocky character of the subgrade was the not wholly unexpected result of the extreme speed demanded of the grading contractors.

Night Lighting—Daily operations running from a minimum of 14 hr. to a maximum of 24 hr. required a large amount of lighting for night work. The contractors assembled a varied collection of specially built and improvised units for generating electric current and for floodlighting the work. Among generating units it was possible to find everything from a 6-v. wet-cell battery used to run a 50-w. lamp on a finishing bridge to 5,000-w. gasoline-electric generating sets mounted in housing on adapted truck chasses. Lights ranged from 50-w. and 100-w. lamps mounted with reflectors on posts or poles to 300-w. and 500-w. floodlights carried on portable towers equipped with housed-in generating plants.

Administration—Paving of the Pennsylvania Turnpike was consummated under the direction of Samuel W. Marshall, chief engineer, and Roger B. Stone, chief construction engineer, excepting in tunnels, where Richard M. Merriman, chief engineer of tunnels, was in charge of all work.

In addition to contractors whose names are mentioned in the text or in the captions appearing with the photographs, the following firms executed Turnpike paving contracts: Adam Eidemiller, Greensburg, Pa.; Wm. O'Neil Sons' Co., Faribault, Minn.; Frank Mashuda, Milwaukee, Wis.; Shullo Construction Co., Akron, Ohio; Harrison Construction Co., Pittsburgh, Pa.; States Engineering Co., Rapid City, S. D.; and Johnson, Drake & Piper, Inc., Freeport, L. I., N. Y.

* * *

Floating Tower Derrick ERECTS ARCH SPANS

(Continued from page 66)

photographs. Deck engines maneuvered the catamaran by means of anchor lines running to anchors up and down stream.

To complete the erection of trusses and floor steel in the side span and to erect floor steel of the arch span, the floating derrick assembled deck travelers on floor members previously erected between the channel pier and the falsework bent. Ordinarily, two deck travelers worked on the side span and one deck traveler on the arch span.

Except for nine simple girder spans at the west approach and seven at the east approach, the design utilizes Wichert pinned rhomboid panels over the intermediate piers of each multiple-span group. In addition to the three-span groups crossing the channels, the bridge includes the following units of Wichert design: (a) a three-span continuous truss; (b) two seven-span continuous girders; (c) a six-span continuous girder; and (d) a four-span continuous girder. Continuous girder units are supported by rocker bents at all intermediate piers with the exception that a reinforced-concrete bent is placed at, or adjacent to, the midpoint of each of the six-span and seven-span groups. Trusses

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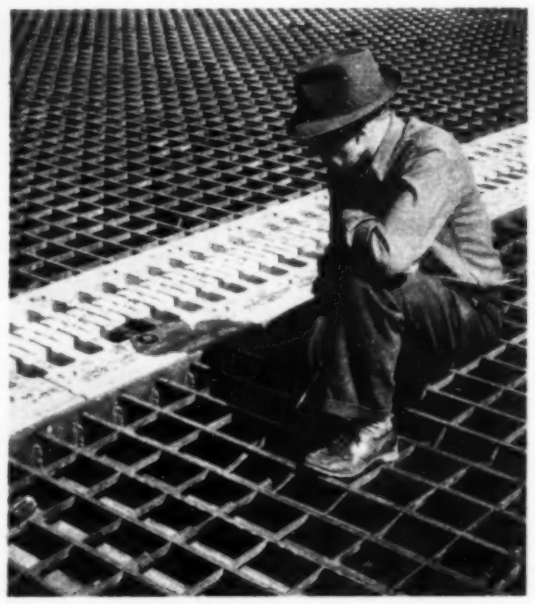
of the channel crossings are spaced 55 ft., c. to c., while girders and trusses of the remaining spans, all deck type, are 36 ft., c. to c.

Bridge Deck—Reliance steel grid reinforcement, shop-welded in panels about 4½ ft. wide by about 20 to 40 ft. long, with sheet steel underfloor concrete forms attached, were welded in place on 345,000 sq. ft. of roadway 46 ft. wide under subcontract by the J. K. Welding Co., Long Island City, N. Y., which put on the job



WELDING OF I-SECTION STRINGERS in grid reinforcement to steel dam at finger expansion joint is examined by Arthur A. Miller, in charge of deck welding for J. K. Welding Co.

sufficient welding operators and generator units to keep the deck welding up with the riveting gangs of the general contractor. Concrete deck paving 5 in. thick, covering the steel grid reinforcement to a depth of ¾ in., was placed on the bridge by another subcontractor, the Corbetta Construction Co., New York City.

Progress—Erection of the 15,000 tons of steel in the bridge started Sept. 11, 1939. The steel, fabricated at Pottstown, Pa., and transferred from railroad cars to lighters at Philadelphia, was towed to the site. Because of heavy ice conditions during the unusually severe winter, no steel could be delivered to the bridge from Dec. 29 to Feb. 12. As a result, completion of the bridge, originally scheduled for June 20, was expected to be delayed about 22 days.

Administration—Financed by a bond issue and a PWA grant, the new toll highway bridge, costing a total of about $3,500,000, is a project of the Maryland State Roads Commission, with design and construction supervision by the J. E. Greiner Co., consulting engineers, Baltimore. For the consultants, B. W. LeSueur is resident engineer in charge at the site. Steel erection was directed for the Bethlehem Steel Co. by G. C. Land, resident engineer; deck welding, for the J. K. Welding Co., Long Island City, N. Y., subcontractor, by Arthur A. Miller; and concrete paving, for the Corbetta Construction Co., New York City, subcontractor, by R. M. Chamberlin.

Wood Panel Forms FOR BUILDING CONCRETE DAMS

(Continued from page 47)

pour, limited by the speed of placing concrete to prevent the generation of excessive heat, will not permit accelerated placement.

Apparent disadvantages of this type of form compared to the single type form are:

(a) Double panels require nearly twice the fabricated form area in place at all times, decreasing the number of reuses of each panel and adding to final form cost.

(b) With double panels it is necessary to pry the lower panel loose from position and swing it out to clear the panel above. If a crane is used, this objection is not so great.

Single type panels were designed and used successfully at Chickamauga (Fig. 2) and Hiwassee (Fig. 3). This type of panel is lifted vertically and is supported by rods provided in the previously poured lift. It is particularly adapted for hoisting with A-frames, and it eliminates delays waiting for a crane or cableway which might be doing other useful work.

Top Wale

A steel ship channel at the top of the form provides durability and rigid alignment and prevents kinking along the top. The strength of the channel as a wale on the Hiwassee form exceeded requirements under normal placing conditions, permitting spacing inclined ties 8 ft. on centers, thus effecting considerable economy.

Pipe Struts—With a 10-ft. lift it is not always practical to save the inclined panel braces. Consequently, the 2-in. pipe, ordinarily used as a brace, has been combined with the inclined tierod. This arrangement expedites the labor of aligning the panels because adjustment is made simply by turning a bolt. It also gives an axial load on the tension assembly and reduces the possibility of deflection at the top of the form when under load.

If the diagonal or tension member is connected to the form at a point below the top of the lift, bending in the studs is reduced; however, the hanger bolt or sleeve bolt must then be removed from the concrete. Time studies of the operation of removing sleeve bolts on other jobs show that it is expensive because of the tendency of the sleeve bolt to bind in the form and stick in the concrete. It is also difficult to

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set inclined ties to pass through the form at the desired locations; common inaccuracies require drilling of new holes which damage the form and weaken the wale.

Shear in Bottom Bolts—Because the top reaction of the form pressure must be taken by the diagonal member, a vertical component is introduced into the form. This vertical load must be taken in shear by the bottom bolts. If the bolts have bearing only against the wood of the panel, the load will compress the fibers and permit the panel to drop slightly, allowing the inclined rods to rotate and permit the top of the form to deflect outward. To prevent this condition, a small angle iron was attached to the form at the bottom of the lagging. This angle rested upon the bolts in question and carried the entire load. An open space in the lagging just below the small angle iron permitted the workmen to see to enter the anchor bolt into the form anchor.

Size of Anchor Bolts—In determining the size of hanger bolts and bottom wale bolts, the additional load in the top bolt, due to its being at a diagonal, was considered to be about balanced by the combined shear and tension in the lower bolts. Upon this assumption, both bolts were made the same size and spacing for simplicity. Top and bottom bolts were made 1-in.-diameter round with variable spacings ranging from 4 ft. to 8-ft. on centers on the various jobs.

Size of Panels

The Pickwick, Guntersville and Chickamauga jobs employed 10-ft.-lift panels, while Norris and Hiwassee, because of the large mass of concrete in a block, were limited to 5-ft. lifts.

Ordinarily the chief advantages of a 10-ft. form over a 5-ft. are: (a) less cleaning of concrete surfaces, because only half as many surfaces are exposed; (b) less lost time of carpenters moving from block to block in the erection of forms; (c) less lost time moving concrete placing equipment from block to block; (d) less lost time moving the concrete crew from block to block.

There is a tendency now to construct form face panels of sufficient length to form the entire face of a single lift in one operation. This type of form should be of sturdy construction, especially if handled by a crane and subject to stresses imposed by the swing of the crane and by winds. Guntersville adopted this type, some of the panels being 42 ft. long. Hiwassee used single lift panels, some being 50 ft. in length. Chickamauga at first adopted shorter sections but found that the A-frames could satisfactorily handle these sections bolted together for the entire length of a block. These Chickamauga sections were somewhat assorted in size and had the advantage of uses in various places. Pickwick main panels were 26 ft. long. Norris used a 20-ft. maximum length panel.

While the details of panel design and supports vary for each job, the weights of panels per square foot are reasonably consistent as an accompanying tabulation indicates.

Number of Panel Uses—Careful consideration should be given to the number of panels to be fabricated. These considerations should embrace: (a) construction schedule and sequence of pours; (b) mixer plant capacity; (c) variety and size of

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DETAILS OF HIWASSEE PANELS

TYPICAL DOWNSTREAM PANEL

Length, overall	50 ft. 3 in.
Length, contact	50 ft. 0 in.
Height, overall	9 ft. $\frac{7}{16}$ in.
Height, lagged	7 ft. 4½ in.
Height, contact	5 ft. 8$\frac{7}{16}$ in. & 5 ft. 10$\frac{7}{16}$ in.
Area, lagged	50.25′ x 7.375′ = 370.59 sq.ft.
Area, contact	50.0′ x 5.78′ = 289.0 sq.ft.
Weight (incl. hardware & scaffold)	= 9,033 lb.
Weight per sq. ft. of lagged area	= 24.37 lb.
Weight per sq. ft. of contact area	= 31.26 lb.

BULKHEAD PANEL

Length	48 ft. 0 in.
Height, lagged	6 ft. 3 in.
Height, contact	5 ft. 0 in.
Lagged area	48.0′ x 6.25′ = 300.00 sq.ft.
Contact area	48.0′ x 5.0′ = 240.00 sq.ft.
Weight, without keys, incl. hardware and scaffold	8,516 lb.
Weight, with keys, incl. hardware and scaffold	9,916 lb.
Weight per sq. ft. of lagged area, without keys	28.39 lb.
Weight per sq. ft. of lagged area, with keys	33.05 lb.
Weight per sq. ft. of contact area, without keys	35.48 lb.
Weight per sq. ft. of contact area, with keys	41.32 lb.

WEIGHTS OF WOOD PANEL FORMS
per Square Foot of Lagged Area

JOB	TYPE FORM	APPROX. WT. IN LB. PER SQ. FT.*
Norris	All types	25
Pickwick Lock	Vertical	22
	Slope	18
	Steps	14
Chickamauga	Vertical	22.4
	Slope	20.5
	Steps	22.0
Guntersville Lock	Vertical	28
	Slope	25
Hiwassee	Vertical (without metal keys)	28
	(with metal keys)	33
	Slope (downstream)	24

* Weights do not include keys, except where indicated.

(Continued from page 88)

pours; (d) exact length of monoliths and location of horizontal construction joints; (e) consideration of wall armor in locks; (f) careful thought for alterations for other stages of work to obtain the maximum usage with minimum loss; (g) height of lift and pressures against forms; (h) cost of labor.

One of the first questions is: To what extent can panel forms be used and reused, and to what extent is it necessary to build "in-place" forms? Where these points are not fully realized, the extra labor cost of handling special panels may greatly offset their advantages.

A great aid in determining the number of panel forms to be built is a block layout of the structure. This layout, usually prepared by the field engineering office, should indicate lengths of monoliths, horizontal construction joints and location of wall armor or other features that may be a factor in determining the number of panels which they will permit the erection and stripping of the forms. The use of a minimum number of ties or anchors and salvage of as many as possible for reuse are desirable and mean a material saving in form costs.

The type of panel adopted will often affect the selection of fixtures, but in any case the panels should be of a flexible type permitting an adjustment in spacing of ties, without injury to the panels, to meet variations in concrete pressures. A removable clamp which can be easily shifted at the top of the form and a split wale at the bottom of the panel to permit respacing of the bottom anchors make an ideal flexible form.

Proper spacing of tierods is extremely important. The spacing for horizontal threaded ties, based on an allowable stress in the rod of 20,000 lb. per square inch on the net area at the root of the thread, is indicated on an accompanying chart, Fig. 4. A second similar chart, Fig. 5, gives rod spacings for horizontal pressures resisted

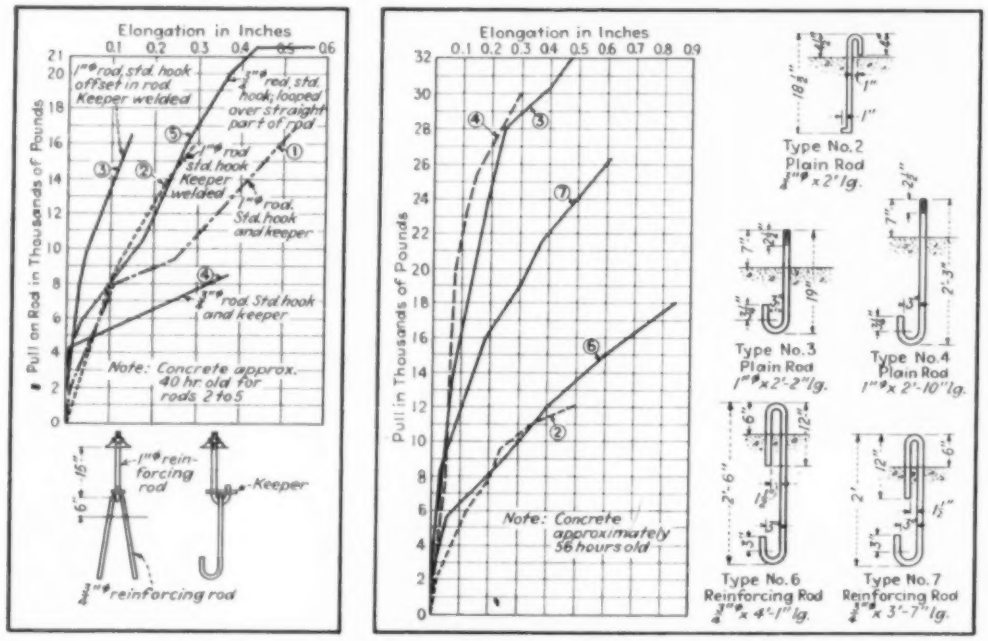

Fig. 6 . . . **(left) TESTS ON WICKETS AND TIERODS** at Pickwick Dam, with specimens in positions simulating actual construction conditions, produce elongation curves which suggest desirability of finding simpler and more serviceable type of anchor. Fig. 7 . . . **(right) ADDITIONAL TESTS** (represented in part by assemblies and curves above) made at Pickwick Dam lead to choice for this job of Type No. 4 anchor consisting of hooked rod threaded at upper end and connected to tierod by sleeve nut.

and the probable usage from each. With the use of colors these blocks can portray a real picture of the entire program. The highly important elapsed time between concreting and stripping a form is indicated on such a block layout, as also is the sequence of pours. Generally, alternate blocks take the lead, followed by "fill-ins" which, of course, require no bulkhead forms. In case of a lock it often is advantageous to work both ends or both walls for an economical arrangement of panels.

Form Accessories—One of the first considerations in starting the design of a form is the economy of the fixtures, that is, of the anchors, ties, or other means for overcoming the concrete pressure against the form. The economy of the fixtures is influenced by first cost as well as by simplicity of design and by the ease with by rods inclined at an angle of 45 deg. These charts were compiled by H. W. Hunt and H. R. Kinzer.

There are many patented form accessories on the market today. Most of them merit consideration in their own particular fields, but none should be used haphazardly, without full consideration of the duties and conditions to which they will be subjected. On jobs of a magnitude comparable to those built by TVA, some expense is warranted in making tests to determine the feasibility of certain features. Several tests made by the Authority are here briefly described.

Form rod tests were made by H. T. Lofft at Pickwick dam in an effort to determine the cause of lateral movement of forms as

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concrete approaches the top of a 10-ft. lift. Tests were made on wickets and tierods in positions simulating actual operating conditions. An accompanying drawing, Fig. 1, shows a typical detail of the type form for which the tests were made, while a chart, Fig. 6, shows the type specimens used and the elongation curves plotted from the results of tests No. 1. In order to arrive at a more satisfactory anchor, additional tests were made on other types of anchors. The types of anchors and the elongation curves for the latter tests (No. 2) are indicated in Fig. 7.

As a result of these tests, it was decided to use anchor type 4 of tests No. 2. This anchor consisted of a straight rod threaded at the upper end and a hook buried in the concrete. The tierod was fastened to the threaded end of the anchor by means of a sleeve nut, and the straight axial load, with the absence of hooks and loops in the assembly, developed the least elongation with this arrangement.

Chickamauga Tests—Tests were made at Chickamauga dam on Tyloop anchors for concrete forms. These anchors had been successfully used on other projects and had several distinct advantages over other anchors for this type of formwork. However, because they were being used at Chickamauga for the first time by TVA, tests were made to compare various sizes and arrangements, to prove the feasibility of this type of anchor and to select proper sizes.

Fig. 2 shows typical details of the panel form and the anchor system used at Chickamauga. Pertinent features of the design are as follows:

(1) The 2-in. pipe diagonal brace acts as both tierod and strut but does not pass through the form. To minimize lateral deflection of the form, the tie-brace is made up of concentric parts. The pipe is cut from second-hand tubing when such is available. Cost of this feature is comparatively high, and tests have been made to eliminate the process of welding the coil inside the pipe. These tests consisted of welding to the coil four ⅜-in. high-test steel rods which were welded at the other end to the outside of the pipe. This arrangement eliminates some of the welding difficulties and, for its length, is cheaper than for the same length of tubing.

(2) The Tyloop anchors have large threads for speed in threading, tightening, and removing; the extent of damage to the thread is reduced with increased size, effecting further saving.

Tyloop Tests—Typical failures in Tyloop tests showed excessive elongation of the Tyloop struts, the resultant movement of the tie coil spalling a cone of concrete from the surface. Such spalling of concrete would reduce the shear resistance of the bolts that support the entire load of the form. Should the bolts allow the form to drop slightly, the diagonal tierod at the top would then let the form deflect outward.

After these tests, the results of which are shown by Fig. 8, it was decided to select a four-strut Tyloop of 0.333-in. diameter wire to insure a factor of safety of about two, to reduce the elongation as

much as possible and to prevent spalling of the concrete.

Anchors for Form Rods—Fig. 9 illustrates two of various types of anchors that were tested at Chickamauga. Although hooked ends on the anchors proved satisfactory, crimped anchors were designed to be more easily and accurately placed in the concrete. A hook on the end of the rod makes it hard to place an anchor correctly, especially when large pieces of aggregate fall at the anchor's location. By using a crimp in the rod, sufficient resistance is

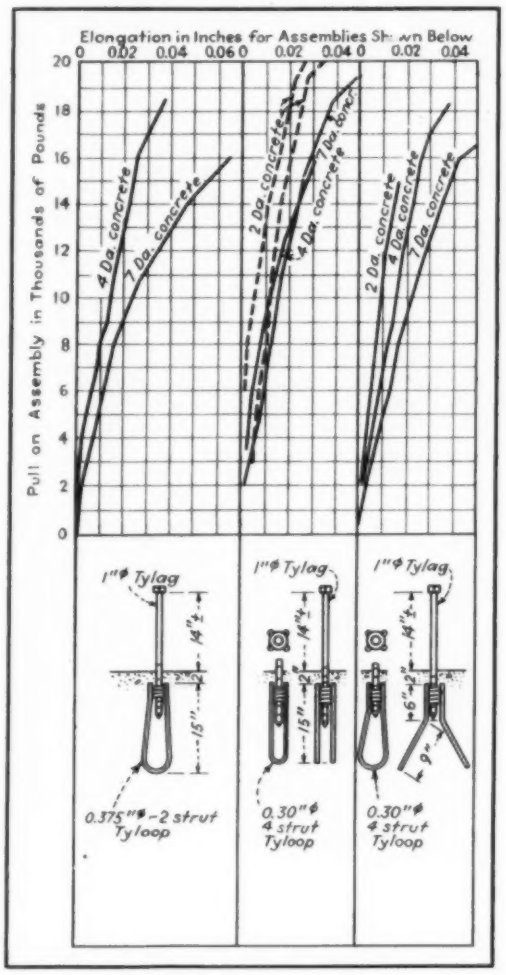


Fig. 8 . . . **AS RESULT** of testing to failure Tyloop assemblies shown above, at Chickamauga dam, four-strut Tyloops are selected to reduce elongation.

developed in tension, and the rod has a single point that is easy to drive into the concrete at the desired location. Tests on this type of anchor showed results as good as, or better than, the plain hook for working loads and developed the strength of the Tylag bolts.

Pipe Sleeves—Attempts to measure the elongation in a pipe sleeve itself (Fig. 9) and to compare it with the elongation for the entire assembly, in order to determine the net elongation other than that due to the pipe sleeve, were not entirely successful. It proved difficult to arrange the Ames dial in such a way that the readings would not be affected too much by straightening of the angularity of the joints. In all cases the pipe sleeves developed the strength of the lag bolts and at no time did they show any distress.

Another test, run on pipe sleeves, was similar to the one just described, except that a five-turn Tycoil was used instead of

(Continued on page 94)

(Continued from page 93)

the seven-turn Tycoil in Fig. 9. This tie coil was welded at one end only. The first pull of 20,940 lb. showed no appreciable elongation in the pipe and stretched the

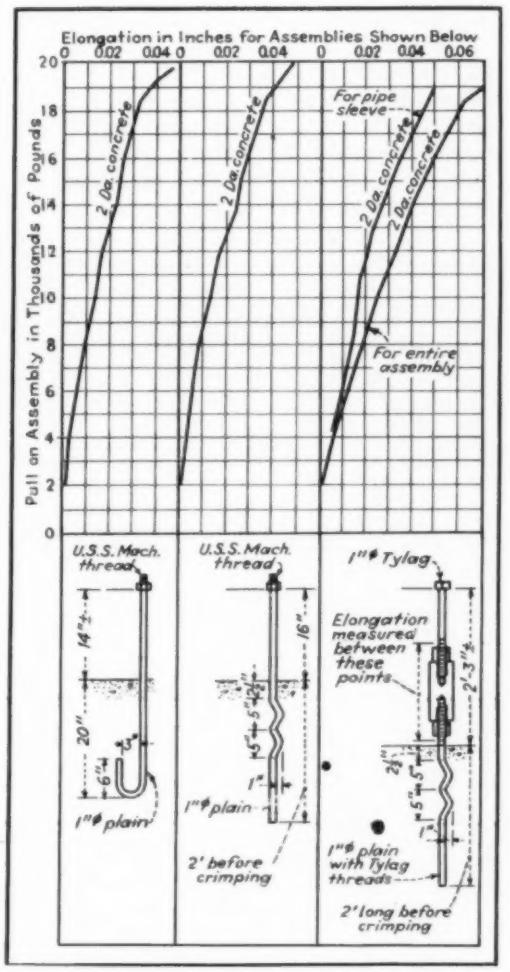


Fig. 9 . . . **VARIOUS TYPES OF ANCHORS,** indicated only in part by three assemblies shown, are tested at Chickamauga dam, and crimped anchor bolt is chosen because it can be easily and accurately placed in concrete. Test of pipe sleeve is discussed in accompanying notes.

lag bolt threads ½ in. The second pull of 24,400 lb. broke the coil loose from the pipe at the weld.

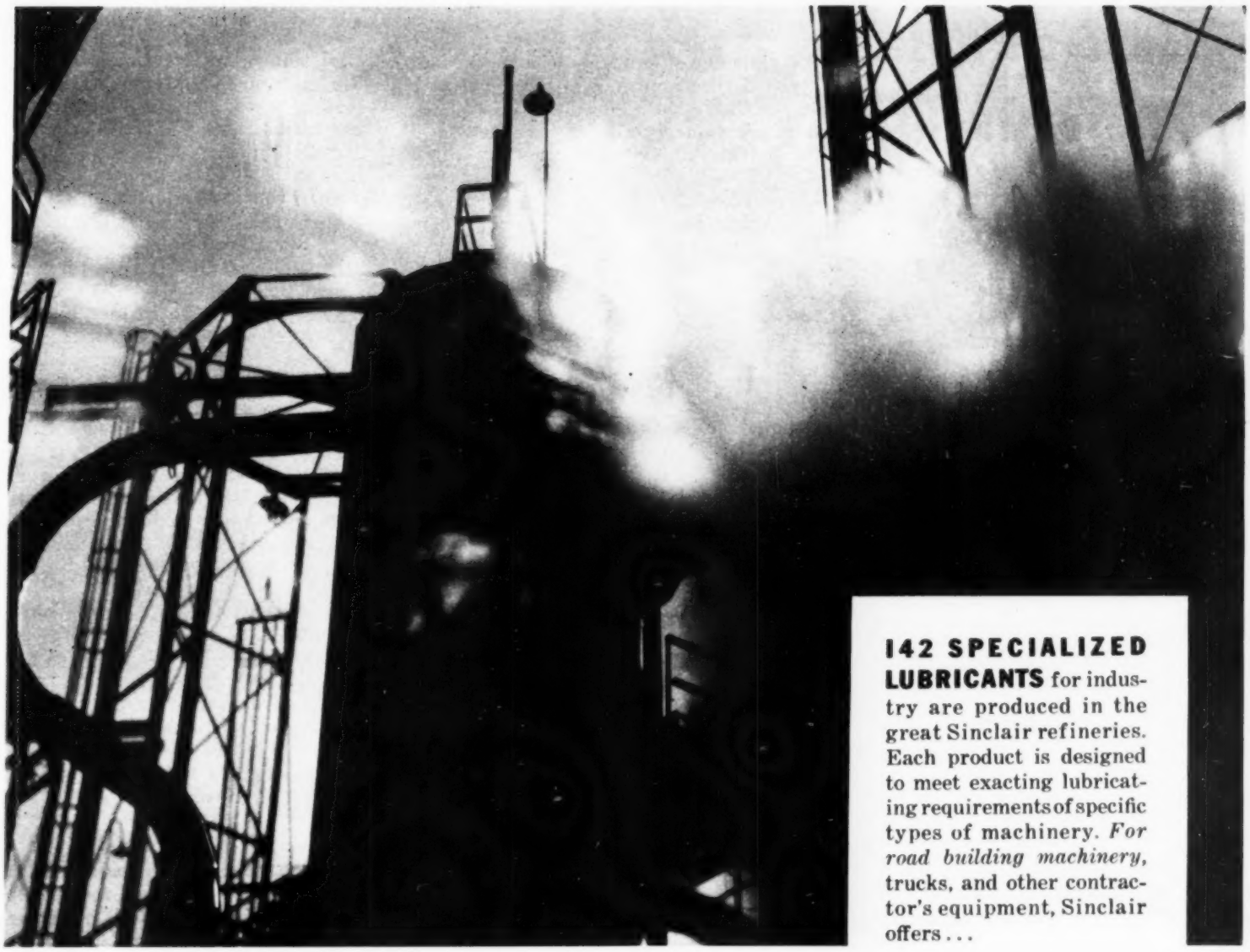
Pipe Coupling Test — A test was run using tie coils welded at both ends to 2-in. pipe which was cut in two, threaded with a standard pipe thread and coupled again with a standard 2-in. pipe sleeve coupling. No elongation in the pipe sleeve or coupling occurred with 1-in. elongation in the Tylag threads; accordingly, it would seem permissible to use 2-in.-diameter standard pipe couplings for splicing form rods if necessary.

Hiwassee Tests — Hiwassee adopted a form similar to the Chickamauga form and determined the length of Tyloops by tests. Later, this job decided to use "summer" or "low-heat" cement which does not develop strength rapidly enough to resist the pull in the Tyloops, and provision was made for additional embedment and the adoption of Universal sleeve bolts.

Additional Form Design Recommendations

(1) Avoid, if possible, the use of a top timber wale with bored holes for attaching tierods. Experience proves that, because of

(Continued on page 96)



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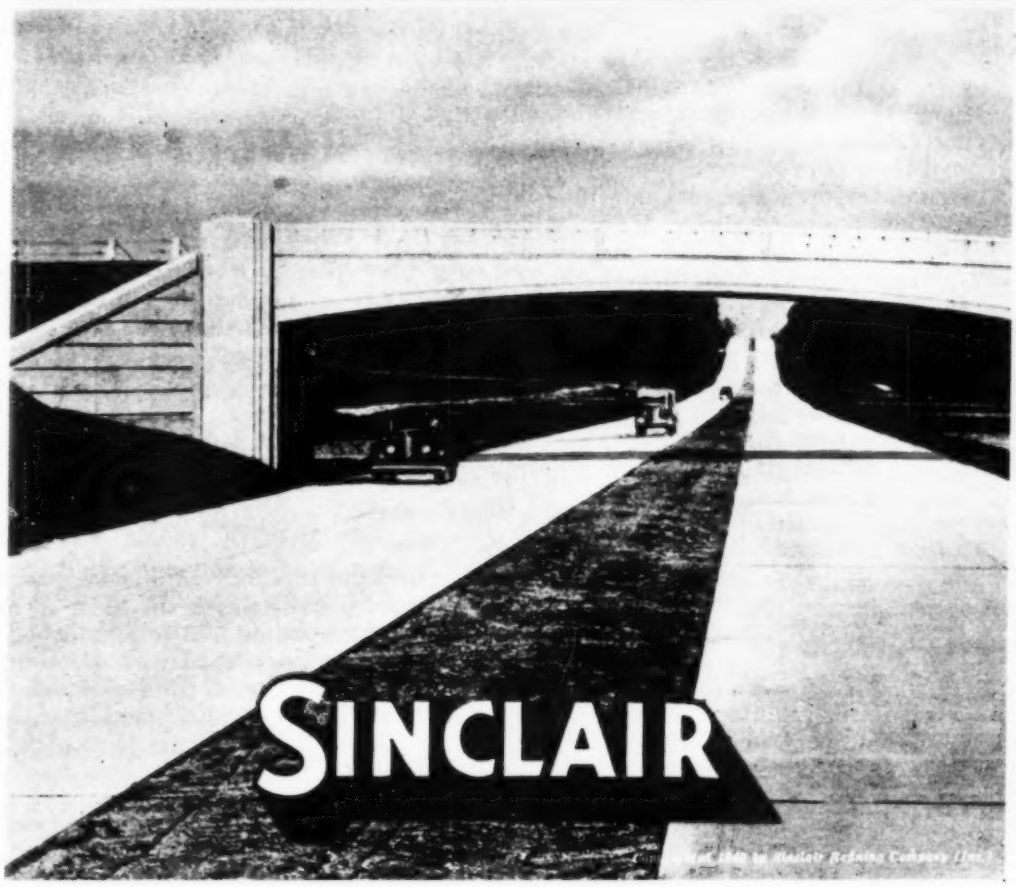

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(Left) **NEW PENNSYLVANIA TURNPIKE.** *Eight different contractors building this new super-highway selected Sinclair products for dependable service in their various pieces of equipment.* *(Photo courtesy Penn. Turnpike Commission)*

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(Continued from page 94)

the difficulty of properly locating anchorages for the lower ends of tierods at right angles to holes already bored in the wale, it is common practice to bore new holes through the wale opposite the actual positions of the anchorages. As a result, after a few uses, the upper wale may have so many holes bored in it as to render it unsafe for future use, introducing an additional cost in replacing the wale and patching the lagging.

COMBINATION TIE-BRACES of steel pipe (equipped at both ends with special inserts to take widely spaced lag screw threads of anchor bolts and of top form bolts) serve TVA for third time in holding forms at Watts Bar. Lightweight aluminum A-frames fitted with adjustable telescopic back-legs raise single-course panels by means of ratchet-lever chain hoists.

(2) An improvement in panel form design calls for a steel channel top sill in place of the usual timber wale. On large panels this channel sill has a number of advantages in simplifying the structural arrangement of the panel members and in serving as the point of connection for the tierods which are embedded in the concrete. Other advantages are:

(a) A steel channel top wale permits flexibility in changing the spacing of tierods to suit varying conditions. A movable top attachment such as adopted for Hiwassee is suggested.

(b) The steel channel design helps to keep embedded form accessories to a minimum; this one item of embedded accessories may easily amount to 20 per cent of the form cost.

(3) Safety scaffolds and ladders on all panel forms facilitate erection and stripping and speed up progress, thereby decreasing costs as well as reducing accidents.

(4) Panel forms generally will not prove economical for all form erection, especially on foundation lifts, narrow sections, at intersections of vertical and batter walls, and in topping out blocks. Consideration should be given to these conditions.

(5) In double-row panels, sloping the studs slightly, instead of making them vertical, allows an interlacing of the tops of the studs on the lower panel with the bottoms of the studs on the upper panel. This construction lends itself to the easy removal of the bottom panel without disturbing the upper panel.

(6) Proper selection of anchor bolt stock is important, as it influences such factors as bending, ease of threading and damage to threads in removing from forms. Chickamauga and Hiwassee used a grade equal to SAE 1040,—a high carbon steel (0.35 to 0.45) which has a strength more than 50 per cent greater than the usual mild steel stock. Although the high carbon steel is not so easily threaded, experience indicates that it is readily usable for most conditions.

(7) Equip panels with means for retaining all reusable fittings to prevent their dropping off, endangering workmen below and causing loss of time while replacements are obtained.

(8) Present day navigation locks employ wall armor to protect wall surfaces. Two accepted methods of providing forms to accommodate wall armor may be suggested: (a) Use special sheathing placed in such a manner as to allow an opening for the curved surface of the steel armor; (b) Use standard panels and fill in the intervening spaces between wall armor with plywood.

✥

***NEXT MONTH:*—Shop construction and field handling of wood panel forms will be discussed in the third article of this series, to appear in the next issue.**

* * *

RIVERFRONT HIGHWAY *Squeezes Through Tight Places*

(Continued from page 51)

the land side by reinforced-concrete load-bearing walls and on the water side, where openings are desired to provide day-lighting and view of the river, by a reinforced-concrete girder 6 ft. deep spanning between double steel columns spaced 45 ft., c. to c., between column pairs. The accompanying cross-sections and photographs indicate the structural design. Slabs are continuous over three spans between 1-in. expansion joints 135 ft. apart, and monolithic pours for these slab units required continuous placement of 500 to 700 cu.yd. of concrete.

A variation from standard reinforced-concrete deck construction occurs in two

(Continued on page 98)

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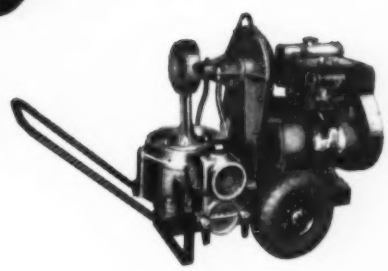

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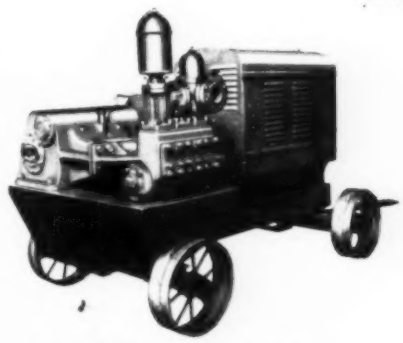

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(Continued from page 96)

transition sections, where roof slab is placed only over the upper curving roadway, offset toward the land side above the lower deck. To support the concentrated loading of the columns in the upper tier, the design incorporates transverse steel girders supported at their outer ends by the lower tier of columns. Longitudinal built-up steel girders, framed into the transverse girders, carry the outer edge of the upper roadway slab.

Deep Water Piers

Three lines of steel-sheeted piers carry the multiple-deck viaduct over a stretch of water just offshore from an existing seawall at Carl Schurz Park on the contract of J. Rich Steers, Inc. Of the 96 water piers, 27 are double expansion units, making a total of 123 steel sheetpile shells. To start pier construction, the contractor's floating plant first drove timber piles and erected timber falsework to aid the setting and driving of steel sheetpiles for the first line of piers nearest the shore. The timber staging was anchored to the existing stone masonry seawall. Two floating piledrivers equipped with McKiernan-Terry 9B3 and Vulcan No. 1 hammers drove both the wood falsework piles and the steel sheetpiles. After construction of the first line of piers had been completed, the falsework was extended eastward in two stages to permit construction of the second and third lines.

Air-lift jets were used with great success by the contractor in cleaning out the steel-sheeted caissons after clamshell and orangepeel buckets had removed as much of the mud as possible. Jets made up of 8-, 10-, and 12-in. pipe were fitted near the bottom with inner welded rings having orifices through which high-pressure air was blown into the pipe, generating a rush of air and water which carried mud and spoil with it to the surface. A diver maneuvered the bottom of the jet in the caisson.

Pipe extensions at the top of the air-lift were added in short sections, 5 ft. long, to keep the discharge end as close as possible to the surface of the river for maximum efficiency. Each jet required 600-700 c.f.m. of air, and the contractor operated two 315-c.f.m. and two 310 c.f.m. compressors hooked up on the deck of a derrick boat to supply two jets simultaneously.

Maximum rock slope permitted by specifications in the bottom of the caissons was 1 on 3. Some rock in the caissons was shattered by operating a steam hammer on an 18-in. spud shod with steel which had been case-hardened with Stellite applied by an electric arc. To level off the rock in most of the caissons, a diver operated a pneumatic paving breaker, with exhaust hose extended above the water surface, in conjunction with an air-lift jet.

Fast progress resulted from these methods of sheeting and excavating caissons. Four 8-hr. shifts, on the average, were sufficient to set and drive steel sheetpiling and to clean out the mud and rock in preparation for placing concrete. Depending upon the depth of the caisson and other

conditions, the time actually consumed by these preparatory operations varied from 4 to 90 hr. Each caisson was inspected by a diver for the city before it was filled with concrete placed by tremie from a floating mixer plant.

All the work had to be carried on in the face of tidal variations of 5 to 6 ft. and tidal currents of 4 mi. per hour. Many operations could be performed only at low tide.

Granite Pier Facing

To protect the concrete within the tide range and to provide good appearance when viewed from the river, the outer line of piers, numbering 43 in all, are faced between low and high water level with three courses of granite about 6 ft. in overall height. As specifications required that the stone facing be bonded directly to the concrete, the contractor faced a problem in erecting the granite courses prior to placing concrete. The difficulty was effectually solved by casting the first two courses in solid rings backed up by 6 in. of concrete, with four U-rods embedded in the concrete to serve in picking up and placing the rings. Stone for the top course was set on the upper ring, and the three courses were filled with concrete.

Floating Concrete Plant — On deck pours, the floating concrete plant placed 500 cu.yd. in 10 to 12 hr. To finish this monolithic roadway slab, 32 ft. wide by 135 ft. long, the contractor operated a self-propelled finishing machine traveling on timber headers at the two edges of the slab.

Complete equipment for batching, mixing, hoisting and chuting concrete was mounted on the hull of the floating plant. A stiff-leg derrick on board handled sand and ¾-in. gravel from barges alongside into the overhead bins of the batching plant. Bulk cement was pumped from a cement barge into a 1,200-bbl. storage bin. A screw and belt combination moved cement from the large bin to a small hopper which fed by gravity to the batching apparatus. All dry materials were batched by weight; water was measured by an automatic tank. The batchers fed two 1-yd. mixers which discharged into the bucket of a tall steel hoist tower. A boom chute and radial chute supported by the tower distributed concrete from the plant to shore.

Steers' Contract Quantities

Work on the Steers' contract, valued at $2,268,000, began on April 24, 1939, and was substantially completed by the specified contract date, May 13, 1940. Materials quantities give some indication of the volume of work accomplished in that period.

To sheet the caisson piers, the contractor installed more than 1,500 tons of steel sheetpiling. In construction of cofferdams, required to build bulkhead walls on the project, another 350 tons of steel sheetpiling was employed.

Nearly 100,000 barrels of sulphate-resisting cement (specified for all concrete in the East River Drive because of its location over salt water) was required for the 62,500 cu.yd. of concrete on the job. Of

(Continued on page 100)

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this concrete, about 5,000 cu.yd. was placed by tremie in the caisson piers, another 5,000 yd. went into the gravity bulkhead wall, and about 14,000 yd. was required for other plain concrete walls. The remaining 42,000 cu.yd. was placed in heavily reinforced viaduct and retaining wall construction which incorporated 2,800 tons of steel bars. Structural steel in the viaduct amounted to 1,800 tons.

At the north end of the job in Carl Schurz Park is a tunnel more than 450 ft. long, excavated in open cut through a rock ridge and decked over for landscaping at park grade. This cut accounts for a good part of the excavation on the job, amounting in all to 15,000 yd. of rock and 33,000 yd. of earth, removed by conventional methods.

Benching Rock Bank

Much more difficult rock excavation was encountered from 58th to 59th St. on the Poirier & McLane contract, where a high bank of Manhattan schist rose at a sharp angle from the water's edge. In this formation, rock strata dipping toward the west are badly intersected by seams which incline toward the river. The contract required cutting the rock bank vertically on a line within 30 ft. of existing private residences and a steam plant six stories high; the foundations of these structures rested on the rock.

To minimize the danger of fractures and slides, the rock was excavated back to the vertical face in short blocks, 20 to 40 ft. long. The design for stabilizing this high vertical rock face consists of reinforced-concrete facing 2 ft. thick which functions as a beam, anchored to solid rock at the top and at the base.

Delicate drilling and blasting operations were required to bench the rock by steps back to the vertical face. During these operations, the rock was pinned by dowel rods driven into drilled holes to prevent dislocations and slides. Most of the drilling was done with hand-held drills supplemented in a few places by light wagon drills. The final vertical face was line-drilled with holes on about 6-in. centers. Kadco dust-collecting equipment was operated on this section and on the Steers' contract to keep down the dust count in the atmosphere during drilling.

Deep Footings—South of 58th St., because of the extremely irregular rock surface, the test borings did not show the locations of unexpectedly sharp breaks in the rock contours. Excavation and leveling of sharply sloping rock at these depths required cofferdamming and pumping and caused unexpected delays in completing the foundations. The footings ordinarily were mass concrete, but in some places pipe piles were installed to provide part of the foundation support.

Next to the river, a steel sheetpile cofferdam was constructed and excavated to depths as great as 30 ft. to permit erection of forms and placing of concrete in a gravity bulkhead wall. Between 56th St. and the north side of 57th St., the contractor installed fifteen steel-sheeted concrete piers of which five were double expansion shells, making a total of twenty, similar to those

ROTARY CAISSON MACHINE sinks cylindrical steel shells to bedrock for four piers at 60th St., on north side of Queensboro Bridge, where overhead ramp will be carried across multiple-deck viaduct.

on the Steers' contract, to carry a portion of the double-deck viaduct.

At the north end of the Poirier & McLane contract, between 59th and 64th Sts., the drive traverses new land created by pumping in sand fill behind a bulkhead of the relieving platform type, constructed under separate contract by the Del Balso Construction Corp., New York City. From 59th St. north, the depth to bedrock increases sharply, and on this section the highway design called for foundations of closed-end steel-pipe piles for all piers except six at 60th St. At this point an overhead ramp crosses the double-deck viaduct, putting an increased load on the foundations, and the designers chose steel shell caissons for the six piers, which are located in close proximity to two under-river tubes of the BMT subway.

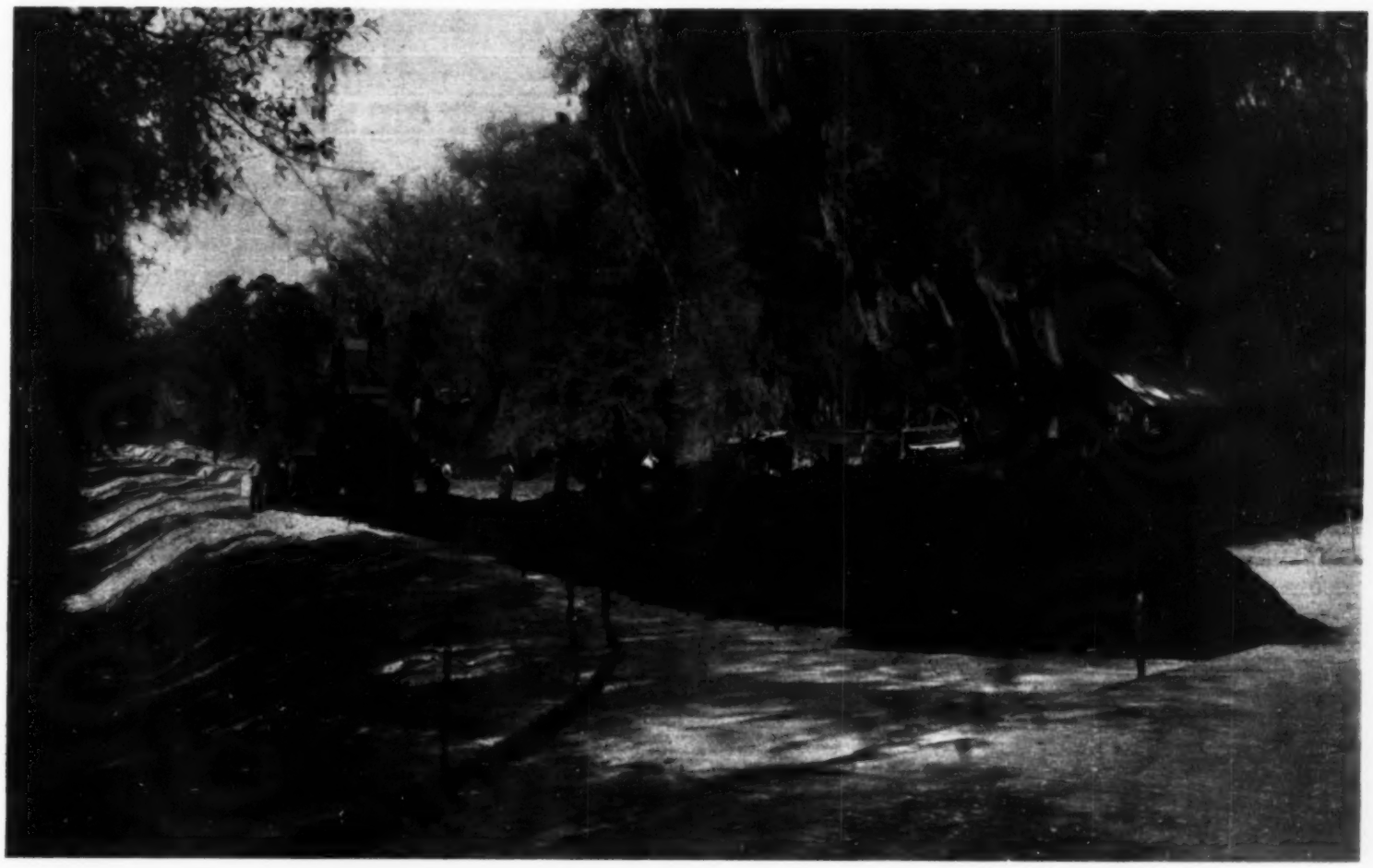
Steel Shell Caissons

A Montee rotary caisson machine sank four of the six steel shells which are 5 ft. to 8 ft. 3 in. in diameter and go down to depths ranging from El.-50 to El.-90. A 40-ton rotary head on the machine forced caisson shells through the soil while high-pressure water jets inside the steel cylinder near the bottom washed the material out from under the cutting edge and up the outside of the shell. The two remaining caissons, not under the highway, have to be put down by other means.

Penetration of the four caisson shells was aided by a cutting edge of 4-in. teeth,

(Continued on page 102)

DUVAL COUNTY, FLA., FORGES AHEAD WITH ITS 1940 ROAD PROGRAM



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(Continued from page 100)

hard-faced with Stellite deposited by the oxy-acetylene process, the points of the teeth being offset ¾ in. The rotor head was turned by a 300-hp. 900-r.p.m. electric motor operating through a 180 to 1 gear reduction, and water was delivered to the caisson at 150-lb. pressure through a 6-in. pipe by a centrifugal pump driven by a 350-hp. electric motor.

Caisson shells went down through sand, clay, gravel, timbers and boulders. All the materials except boulders and timbers were washed out by the flow of water, and the larger objects were mucked out inside after the top cover had been removed from the caisson cylinder. The cutting edge penetrated as much as 2 ft. into ledge rock.

All four caissons landed on rock well above the top elevations of the subway tubes, which are in rock tunnels at these locations. The two other caissons will land close to the tunnels, where the tubes emerge from rock into river sand. One of the caissons is being sunk to rock between the two tubes, which are only about 12 ft. apart.

Truck-Mixed Concrete—To supply 37,000 cu.yd. of concrete required for the job, the contractor erected a Blaw-Knox bulk cement and batching plant on the riverfront about ¾ mi. north of the work and delivered concrete with four 4½-yd. Blaw-Knox truck mixers. The concrete was chuted from the truck mixers to the forms, to crane-handled concrete buckets or to a Rex double-chambered Pumpcrete unit.

Poirier & McLane Quantities—For the work from 54th to 64th Sts., the Poirier & McLane Corp. held a contract valued at $1,420,000. Work started on June 5, 1939, and the specified completion date was May 26, 1940.

Concrete quantities amounted to more than 16,000 cu.yd. in walls, more than 14,000 in slabs, almost 2,000 in tremie, and about 4,500 in miscellaneous work. The six steel shell caissons took about 700 yd., and the steel-sheeted piers about 700 yd. Steel reinforcement totaled 1,600 tons.

Pipe pile foundations called for more than 19,000 lin.ft. of steel tubing, nearly all of it 18-in. diameter, ½-in. wall thickness. Estimated excavation included 7,000 cu.yd. of rock above El. 0.0 and 150 cu.yd. below this elevation, in addition to more than 50,000 cu.yd. of excavation other than rock. Viaduct construction involved 860 tons of structural steel, of which 160 tons was silicon steel.

Administration

Current construction of the East River Drive was conceived and is being carried out by the present administration of the Borough of Manhattan, Stanley M. Isaacs, borough president. All design and field operations are under the direction of the Department of Borough Works, Walter D. Binger, commissioner, and L. C. Hammond, chief engineer. In the field, P. Rizack is division engineer in general charge of construction from 49th to 93rd St. Parsons, Klapp, Brinckerhoff & Douglas are consulting engineers, and Harvey Stevenson is architect.

On the contract between 79th and 90th Sts., Maxwell Kurcias is section engineer, and L. Van Houten is superintendent for J. Rich Steers, Inc., New York City, the contractor. The contract of Poirier & McLane, Inc., New York City, from 54th to 64th Sts., is supervised for the borough by Benjamin Schwerin, section engineer, and for the contractor by Patrick Jordan, superintendent.

* * *

Jacks PUSH CULVERT INTO PLACE

(Continued from page 61)

Joyce step jacks. The jacks were spiked to an 8x16-in. timber placed across the end of the culvert.

After the old timber trestle had been removed jacking of the new concrete culvert was started, and after each shove, blocks were inserted behind the jacks for the next push. The total horizontal travel of the new culvert was 15 ft. and required 61 min. jacking time. Total time elapsed until railway track was ready for operation was 1 hr. 45 min. The job was handled by a crew consisting of 1 bridge foreman with 10 men and 3 section foremen with 20 men.

* * *

Caissons Sunk In Deep Water

(Continued from page 55)

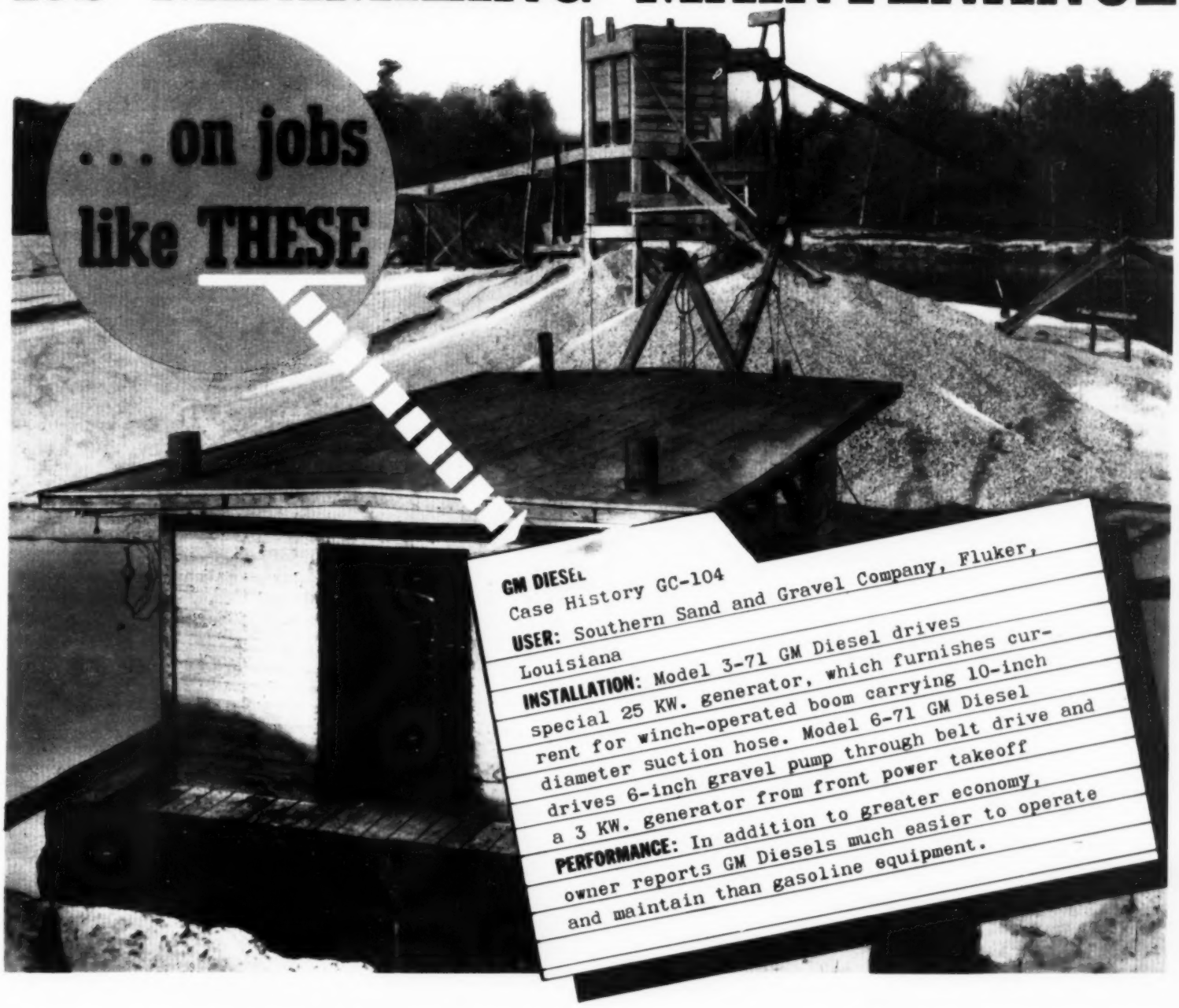
structure was made to function as a unit.

After the 36-in. cylinders had been placed, a row of wood piles 130 ft. long was driven around the upper end, and a wall of steel piles was driven outside and around this upper curved end. This structure effectually cut off the current and made practically still water at the site where the caisson was to be placed. Inside this steel-frame "stall" vertical columns were driven two on each side, one at the upper end and two at the lower end of the caisson, thus holding the caisson in exact alignment.

The timber sheathing, steel sets and 11-ft.-diameter tube extensions then were added, the caisson was built up in about 30-ft. sections and concrete placed therein until the caisson rested on the timber mattress at the river bottom. The mattress then was cut close up to the caisson on the outside and the inner part removed by means of clamshell bucket. The caisson then was carried through the mattress and regular sinking started by dredging with buckets through the 11-ft.-diameter pipe

(Continued on page 104)

It's MINIMIZING MAINTENANCE



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(Continued from page 102)

wells. The concrete walls of the caisson were extended as sinking progressed until the cutting edge reached the final depth of 125 ft.

Consultants on the Mississippi River bridge at Natchez are Ash, Howard, Needles & Tammen, of Kansas City, with Rollin Ritter as engineer representing the PWA. Included in the personnel of the Dravo Corp. on the job were Edward (Red) Weiher, W. A. Robinson, B. N. Parker, and L. D. Kerns.

* * *

SOIL-CONCRETE BASE FOR *Airport Runways*

(Continued from page 44)

two shorter 5-hr. shifts on Saturday.

Single-Course Construction — Stabilization of the base to full 9-in. compacted depth by one-course method was the only economically feasible procedure for runways 150 and 200 ft. wide. Dredged fill had been placed in the runway areas from average El. –12 to El. 20, putting a surcharge of 4 or 5 ft. of gravel above final runway grade. Excess material contained in the surcharge was bulldozed off to the edges of the runways to provide berms 50 ft. wide, upon which a plane could run without getting mired. Filling operations at the airport site had been carried on by end discharge from pipe lines in such a way as to assure homogeneous sand-gravel foundations for the runways, while all silt and fine particles drained off into the intermediate areas, which acted as sedimentation basins. Filling operations were described in *Construction Methods*, March, 1940, pp. 72, 73, 123, 124.

Two-course construction, which ordinarily is desirable and advisable where material is hauled into a project, would have required rehandling of sand-gravel for the upper course in the stabilization of the Washington airport runways. Because of the great width of the runways, windrowing of the material for the second course would have been difficult and expensive. As an alternative, the designers chose to build the 9-in. base in one course, using for this purpose the largest cultivators and disk harrows manufactured. With this equipment the field force is obtaining highly satisfactory results. Beyond a 9-in. compacted depth it is impractical to go with any soil-mixing tools at present on the market.

Runway Drainage — Because of the nature of the sand and gravel subsoil, no sub-drainage is needed under the runway bases. The runways are built with a roof crown, pitched on a straight 1 per cent slope both ways from the center line. At the outer edges of the 50-ft. gravel shoul-

ders (to which are added sufficient loam on the top surface to support grass cover) are shallow ditches which will collect surface drainage and drop the water through inlets to drains which will deliver it to the river by gravity flow through a closed system. Flap valves in the discharge pipe protect the system against backflow at time of river floods.

Stabilization Procedure

According to a comparison made by H. H. Houk, resident engineer on the Washington National Airport for the Interdepartmental Engineering Commission and contact engineer for the Civil Aeronautics Authority on the design and construction, the methods of mixing and compaction for the stabilized runway bases are very close to those used in soil-cement processing, with the exception that soil binder instead of portland cement is added to the material in the grade. The ordinary sequence of construction operations is about as follows:

(1) Surcharged sand-gravel is removed from the runway area, and the remaining material for base stabilization is rough-graded to a loose depth of about 12 in. For these operations, the construction force uses two International 70-hp. diesel tractors equipped with angle-type bulldozers, and two or three Caterpillar diesel 12-ft.-blade road patrols — equipment which serves also in later steps of the stabilization process. An Adams ripper, drawn by one of the 70-hp. diesel track-type tractors, tears up any compacted areas in preparation for the cultivators.

(2) Highly important to the stability of the completed pavement is the second step of the construction operation, by which small crews of hand labor remove all mud, clay or fine sand areas to a depth of 3 ft. or more, as may be required for stability, and backfill with sand-gravel from adjacent surcharge.

(3) To work the top 12 in. or more of sand and gravel into a uniform, homogeneous mixture (free from stratification, laminations and sand or gravel pockets) and to bring oversize gravel boulders to the surface, the construction force operates two heavy cultivators (a Killefer with closely spaced teeth and an Allis-Chalmers with teeth more widely separated) drawn by the 70-hp. diesel tractors.

(4) Hand labor crews remove all gravel boulders larger than a man's fist, 3 in. or more in diameter, brought to the surface by the cultivators.

(5) Blade patrols strike off the loose material to a grade that will allow compaction to approximate final grade.

(6) Binder soil in the proper proportion, determined by sieve analyses of the sand-gravel mixture, is brought in by bucket trucks and is spread in measured rectangles which range from about 15x25 to 60 x25 ft. in area. To employ the maximum amount of labor, both the loading of the buckets and the spreading of the binder material are done by hand. The airport makes use of four leased trucks equipped with Dempster Dumpsters, each truck having a complement of five buckets.

(7) Binder soil is plowed in to a loose

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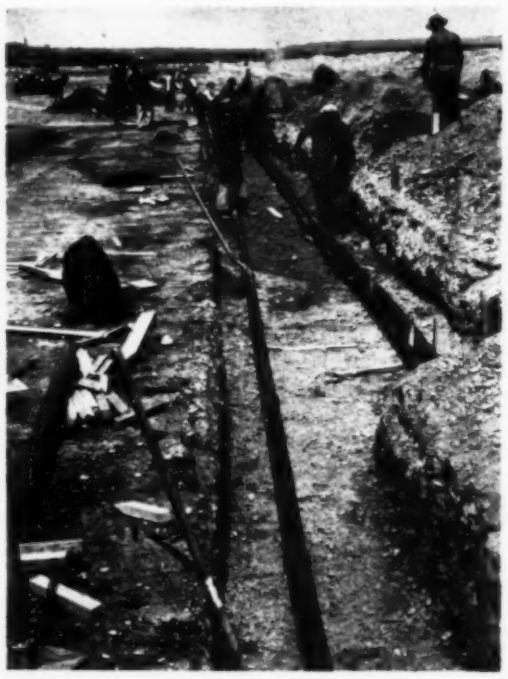
depth of 12 in. or more with an Oliver 18-in. four-bottom gang plow behind one of the 70-hp. tractors.

(8) For thorough mixing of the clay-sand-gravel combination, to a loose depth of 12 in. or more, the constructors again make use of the heavy cultivators and follow them with weighted 28-in. disk harrows of the King Plow Co. Two tandem



CONDUITS FOR LIGHTING and other services are laid in trench along edge of stabilized runway base.

disk plow units of this size are drawn by International 40-hp. wheel-type pneumatic-tired tractors, unless moisture conditions of the soil require use of the heavier 70-hp. track-type tractors. Blade patrols strike off the mixed material ready for initial compaction.

(9) Initial compaction is obtained by weighted multi-wheel pneumatic-tired Bros rollers (known as wobblies on this job) drawn by the wheel tractors; water is applied by sprinkler trucks during this operation as required by soil and weather conditions. Ordinarily, the soil is given a thorough sprinkling prior to rolling by the wobblies.

(10) Following initial compaction, the surface of the stabilized mixture is fine-graded by the blade machines and by two home-made multiple-blade drags manufactured according to a modified Public Roads Administration design.

(11) For final compaction, one of two 10-ton, three-wheel rollers, a Buffalo-Springfield or a Huber, rolls the stabilized base, while sprinkler trucks apply water as required until a layer of soil binder grout moves ahead of the roller.

(12) Field inspectors check final grade and mark any needed corrections of the high and low areas to allowable tolerances of ½ in. in 10 ft. and 1 in. from theoretical grade.

(13) Final ironing, or smooth-rolling, is done by an 8-ton tandem roller, water being applied as required during the operation. Ordinarily, a multiple-blade drag

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makes one pass over the ironed base to roughen the surface slightly for better bond with the asphaltic concrete binder course.

(14) Tar prime is applied to the stabilized base at the rate of 0.3 to 0.4 gal. per square yard, depending upon the absorption by the completed base. Usually the base takes 0.33 to 0.35 gal. The tar prime is purchased at a contract price which includes delivery and application.

These methods (1 to 14, above) produce a 9-in. compacted soil-concrete base having a density of 130 lb. or more per cubic foot and a close texture greatly resembling lean cement concrete in appearance.

Machine Operating Hours

Assuming that the four tractors are engaged in base construction 80 per cent of the time during a work-week of 80 hr., the total tractor time consumed in completing 20,000 sq.yd. of base would be 256 tractor-hours. Estimated average distribution of tractor hours is as follows:

	Hours
Bulldozing	40
Ripping	10
Drawing cultivators mixing rough-graded unstabilized material	50
Plowing with four-bottom gang plow	20
*Drawing cultivators mixing sand-gravel and binder soil	40
Mixing with 28-in. disk harrows	40
*Rolling with pneumatic-tired rollers	50
*Dragging with multiple-blade drags	6
Total	256

*Rubber-tired tractors.

Other equipment employed in the construction of the 9-in. stabilized base furnishes the total number of operating hours estimated below in completing 20,000 sq.yd. in an average work-week:

	Hours
Auto Patrols	
Rough-grading unstabilized sand-gravel	20
Fine-grading stabilized mixture	20
Three-wheel 10-ton flat rollers	60
Tandem 8-ton flat roller	40

Soil Mixture Design

Tests and inspection of base stabilization are carried out by the Public Roads Administration at a field laboratory on the landing field and at the Administration's permanent soils laboratory on the airport site. As a first step in designing the soil mixture for an area of runway base stabilization, the engineers make a sieve analysis of the rough-graded, unstabilized material, which contains no binder. Binder is added to the sand-gravel material to obtain desired plasticity and to provide fines for density.

Binder soil is selected on a basis of plasticity and grading from local areas in upland dry excavation on the airport site. PRA soils engineers calculate the proportion needed to produce the desired plasticity in the final mixture of sand-gravel and binder. The proportion is adjusted to give a plasticity index of about 2 for material passing the 40-mesh sieve.

A certain moisture content is needed in the stabilized mixture for compaction during the rolling operation. Inspectors run moisture check tests, to determine the

amount of moisture present, and recommend the addition of water if necessary. After the stabilized mixture has been rolled to obtain a minimum density of 130 lb., density tests are run to determine if the minimum requirement has been met.

Floodlight Towers — For work that is carried on after dark in base stabilization and paving, the airport is equipped with 28 mobile, skid-mounted floodlight towers, each carrying a Kohler 2,000-watt, 110-volt gasoline-electric generating plant and four S & M floodlamps.

Administration — Complete authority for the design and construction of the Washington National Airport rests with the special Interdepartmental Engineering Commission made up of Sumpter Smith, chairman, of the Civil Aeronautics Authority; Col. R. S. Thomas, district engineer, Corps of Engineers, U. S. Army; W. E. Reynolds, commissioner, Public Buildings Administration; Fred E. Schnepfe, director, Federal Projects Division, PWA; and Major B. M. Harloe, assistant commissioner and chief engineer, WPA.

Stabilized base is prepared, ready for the laying of pavement, by the Corps of Engineers under the direction and inspection of the Civil Aeronautics Authority and the Public Roads Administration. H. H. Houk, of the Civil Aeronautics Authority, is resident engineer, and Captain W. N. Leaf, Corps of Engineers, is officer in charge of construction.

* * *

Prefabricated Wood Scaffolding

(Continued from page 52)

carry on their work without costly delays. The scaffolding consists of 20 uprights 44 ft. high and 100 uprights 54 ft. high. Each upright, as illustrated in the accompanying photographs, is made of two pieces of 3x9-in. select structural Douglas fir, with 3½x8-in. spacing blocks between them, 10 ft. on centers. The spalls, or cross-pieces, 3x9 in. in size, rest on pins for which holes 11 in. apart are provided in the framing plant of the Henry company, where all the framing and prefabricating were done. The uprights are spaced 5 ft. apart laterally and 15 ft. longitudinally. Diagonal bracing is placed both laterally and longitudinally. Scaffold plank is 2x12-in. lumber.

Each scaffold plank is tested, on a 15-ft. span, to nearly twice its working load. This is done, as illustrated, by means of four 200-lb. blocks of concrete and attested and stenciled by the Washington State Department of Labor & Industries. Ordinarily there would not be more than two or three men working on a plank—a maximum of four or five men. Any scaffold plank which showed any sign of distress at all, under this test, was immediately rejected and another brought on to the testing rack to take its place.

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